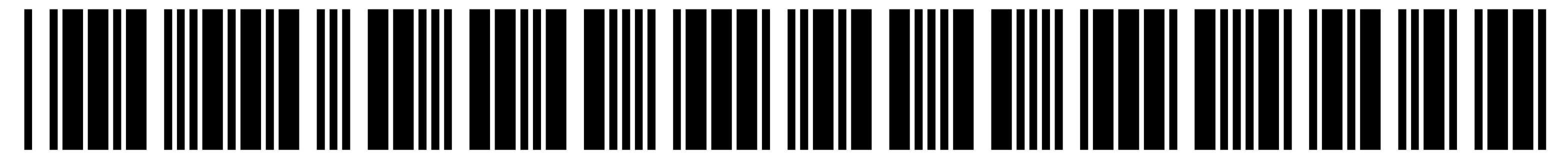

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Waki et al.

(10) **Patent No.: US 6,716,675 B2**
(45) **Date of Patent: Apr. 6, 2004**

(54) **SEMICONDUCTOR DEVICE, METHOD OF MANUFACTURING SEMICONDUCTOR DEVICE, LEAD FRAME, METHOD OF MANUFACTURING LEAD FRAME, AND METHOD OF MANUFACTURING SEMICONDUCTOR DEVICE WITH LEAD FRAME**

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(73) Assignee: **Fujitsu Limited**, Kawasaki (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 12 days.

(21) Appl. No.: **10/226,319**

(22) Filed: **Aug. 23, 2002**

(65) **Prior Publication Data**

US 2003/0006501 A1 Jan. 9, 2003

Related U.S. Application Data

(63) Continuation of application No. PCT/JP00/01433, filed on Mar. 9, 2000.

(51) **Int. Cl.**[7] **H01L 21/44**; H01L 21/48; H01L 21/50

(52) **U.S. Cl.** **438/122**; 438/502

(58) **Field of Search** 438/114, 122, 438/123, 462, 463, 465, 464, 502

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Primary Examiner—Phuc T. Dang
(74) *Attorney, Agent, or Firm*—Westerman, Hattori Daniels & Adrian, LLP

(57) **ABSTRACT**

The present invention relates to a leadless surface-mount resin-sealing semiconductor device and a manufacturing method thereof; in a semiconductor device comprising a semiconductor element, a resin package sealing this semiconductor element, a terminal formed on a mount side of this resin package so as to protrude thereon, and a wire electrically connecting this terminal and an electrode pad on the semiconductor element to each other, a heat sink dissipating heat generated in the semiconductor element is provided on an undersurface of the semiconductor element so as to improve a heat-dissipation property.

11 Claims, 11 Drawing Sheets

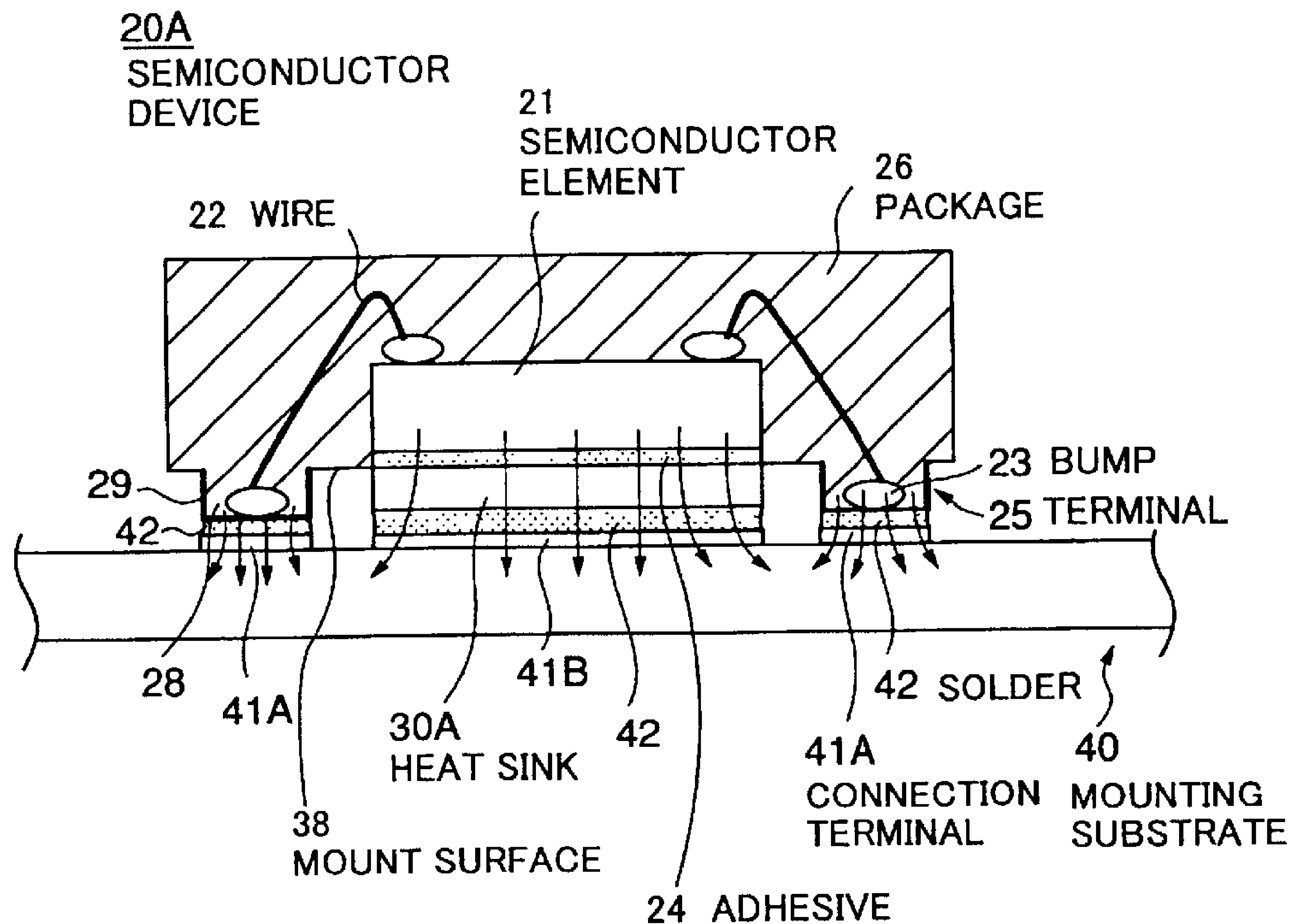


FIG.1 PRIOR ART

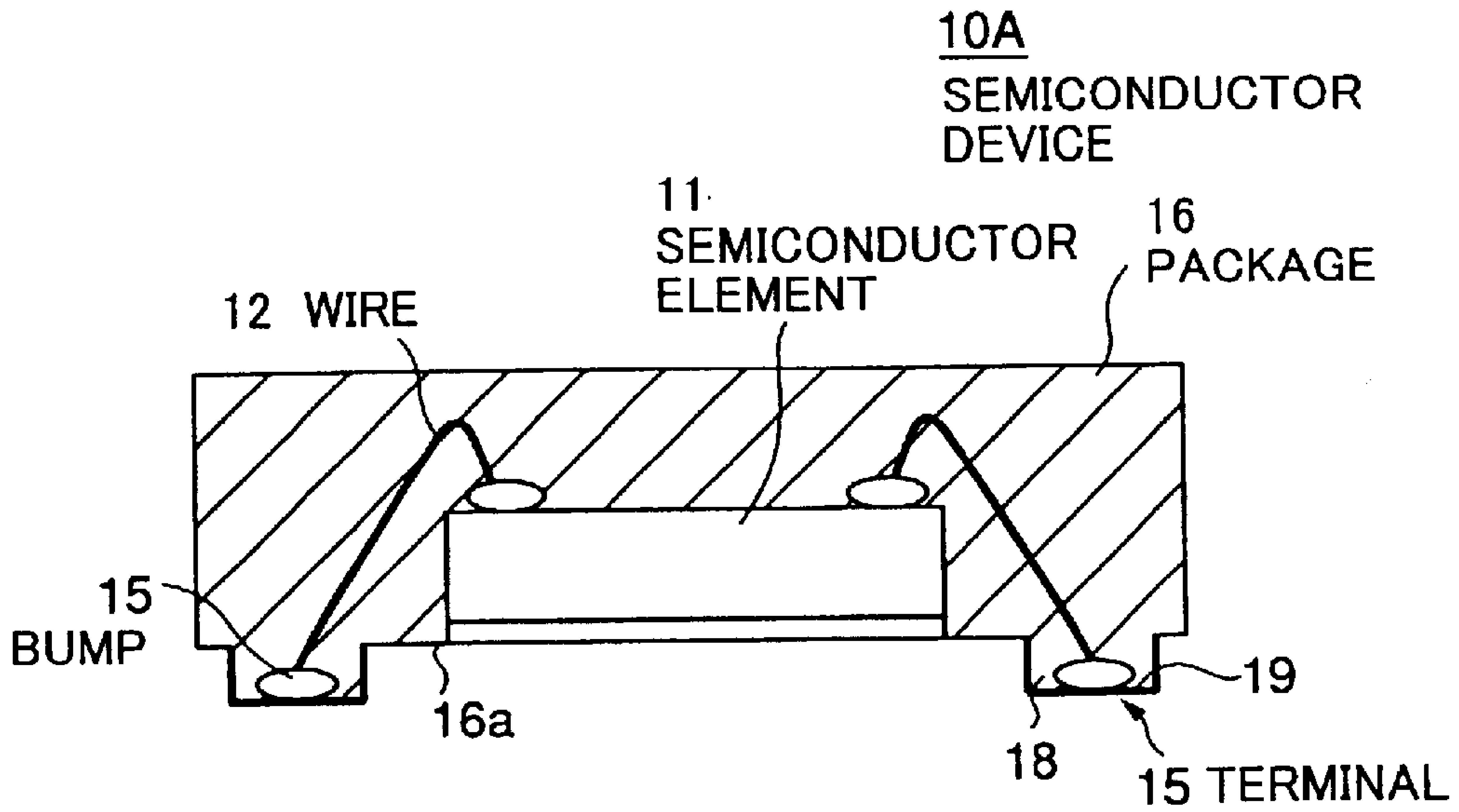


FIG.2 PRIOR ART

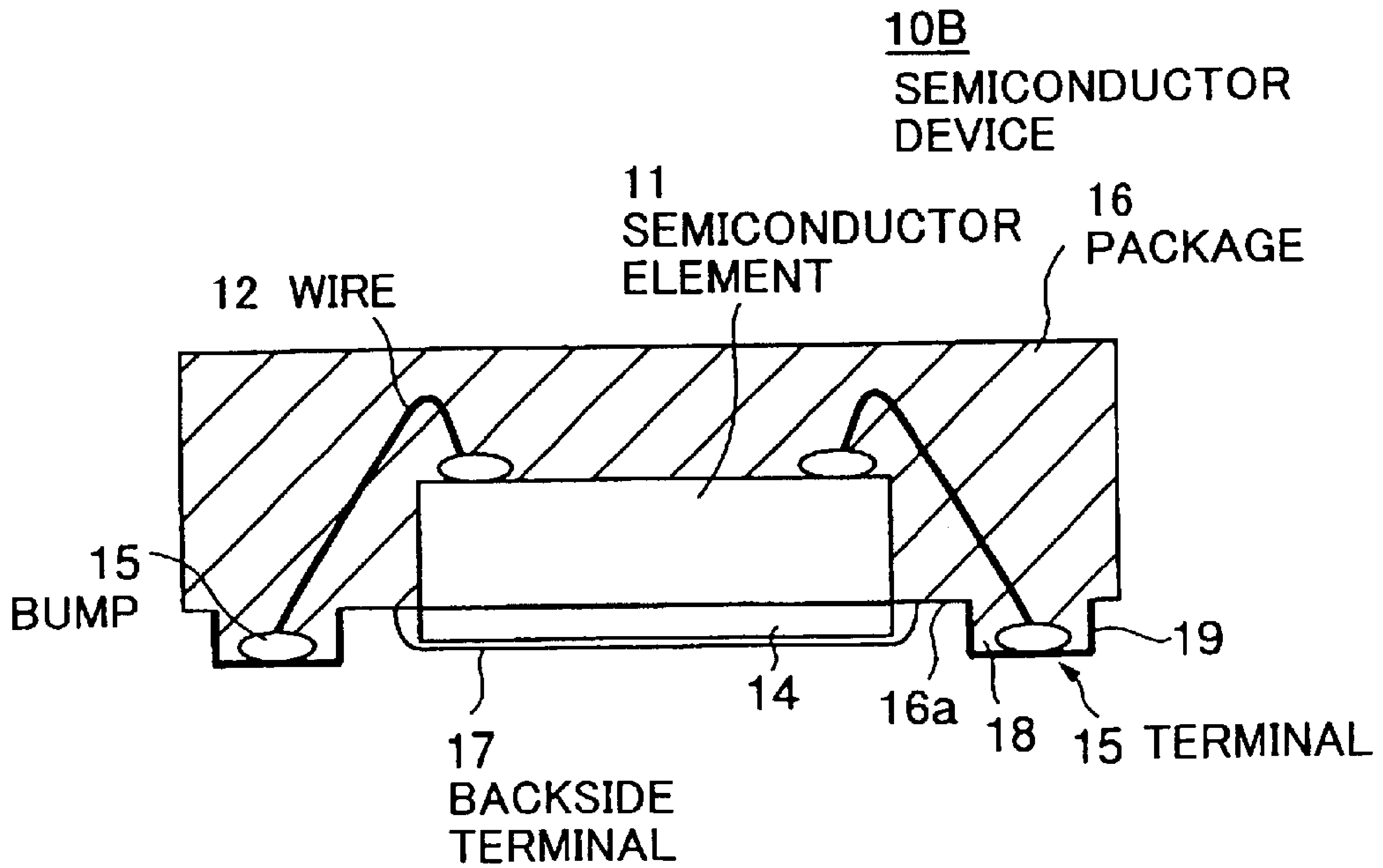


FIG.3

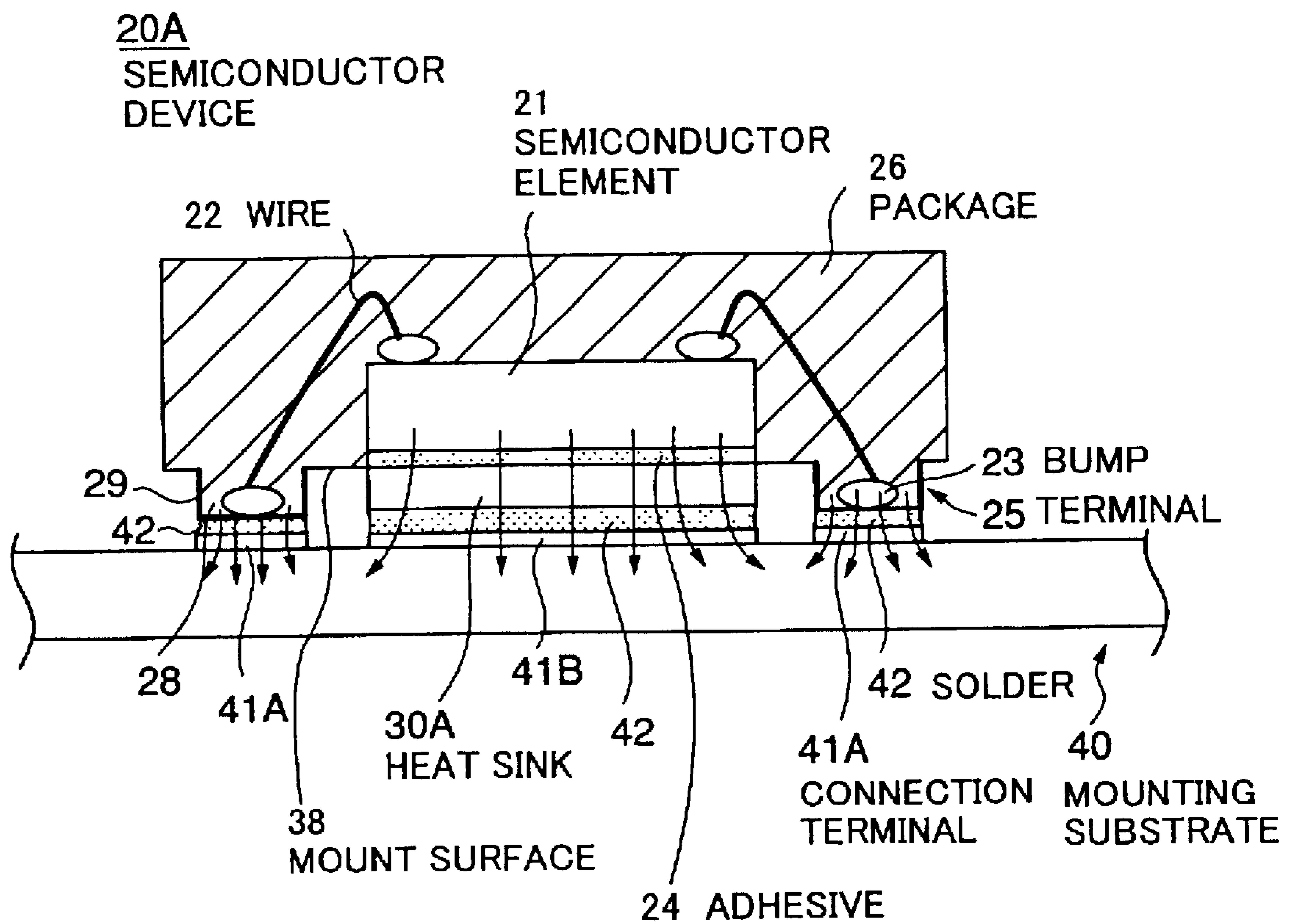


FIG.4A

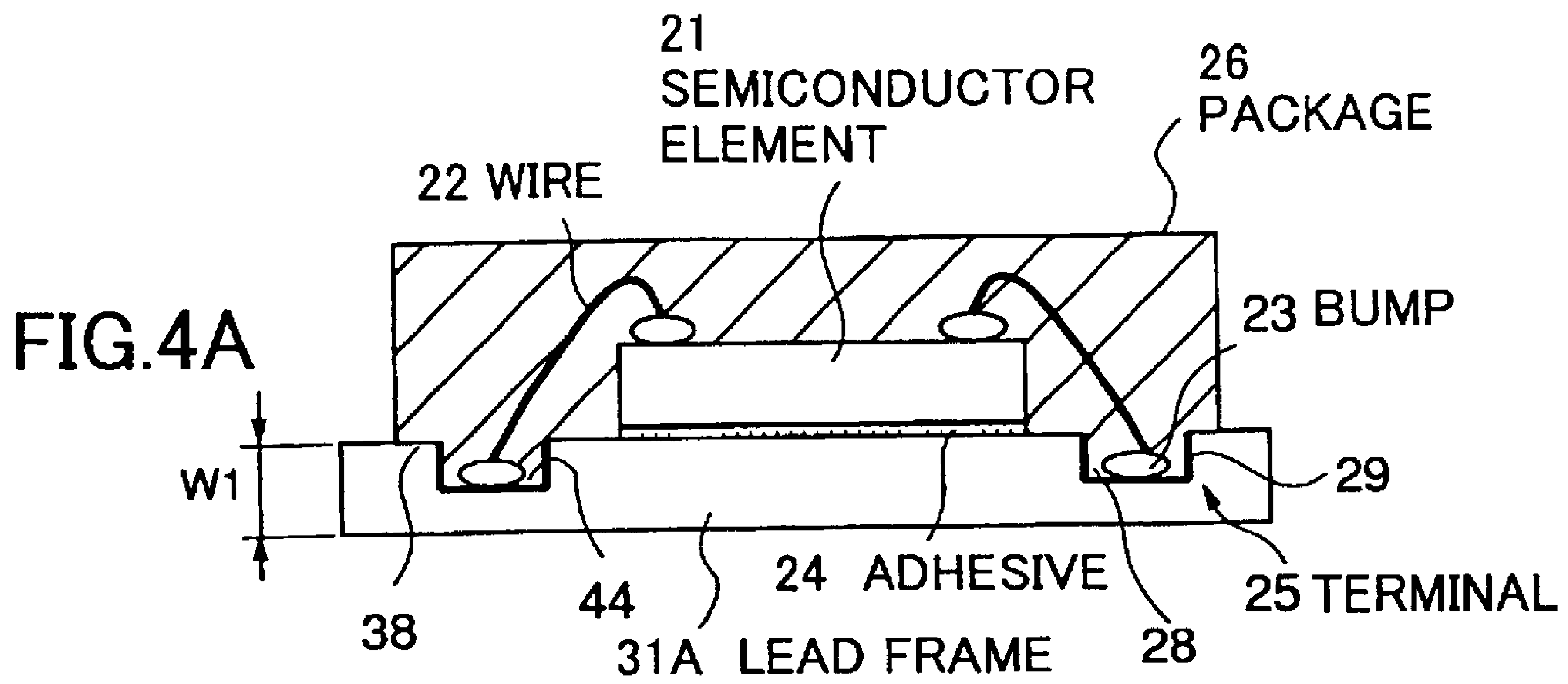


FIG.4B

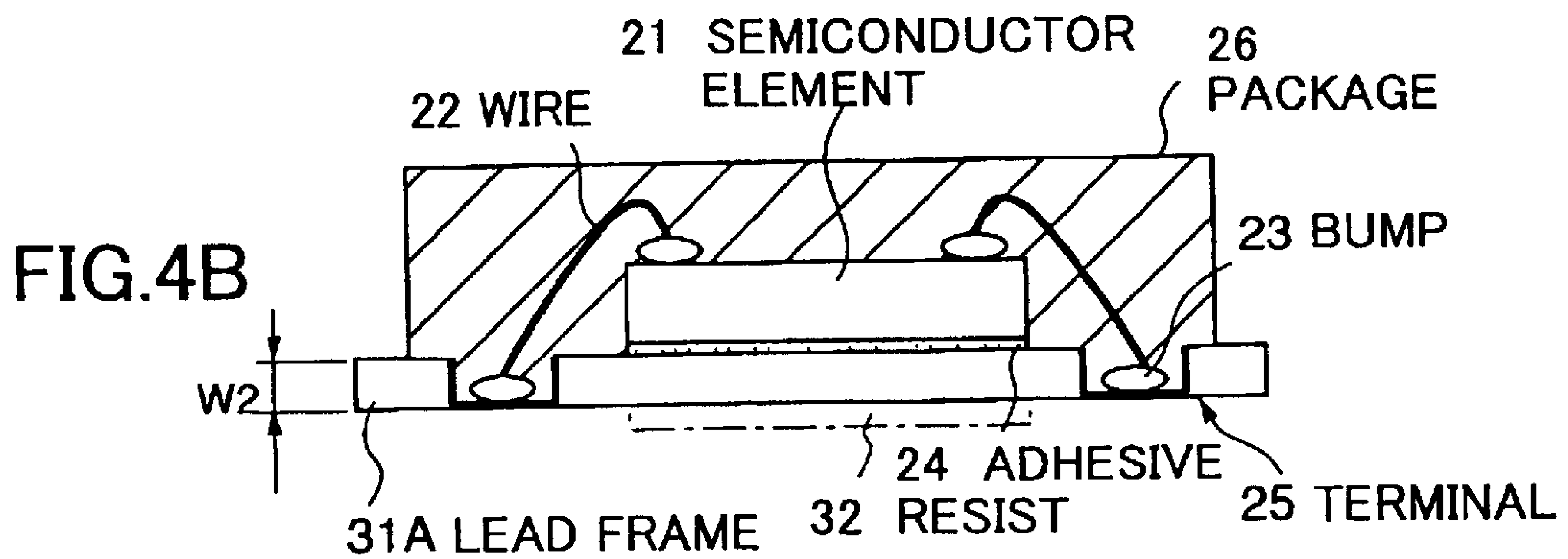


FIG.4C

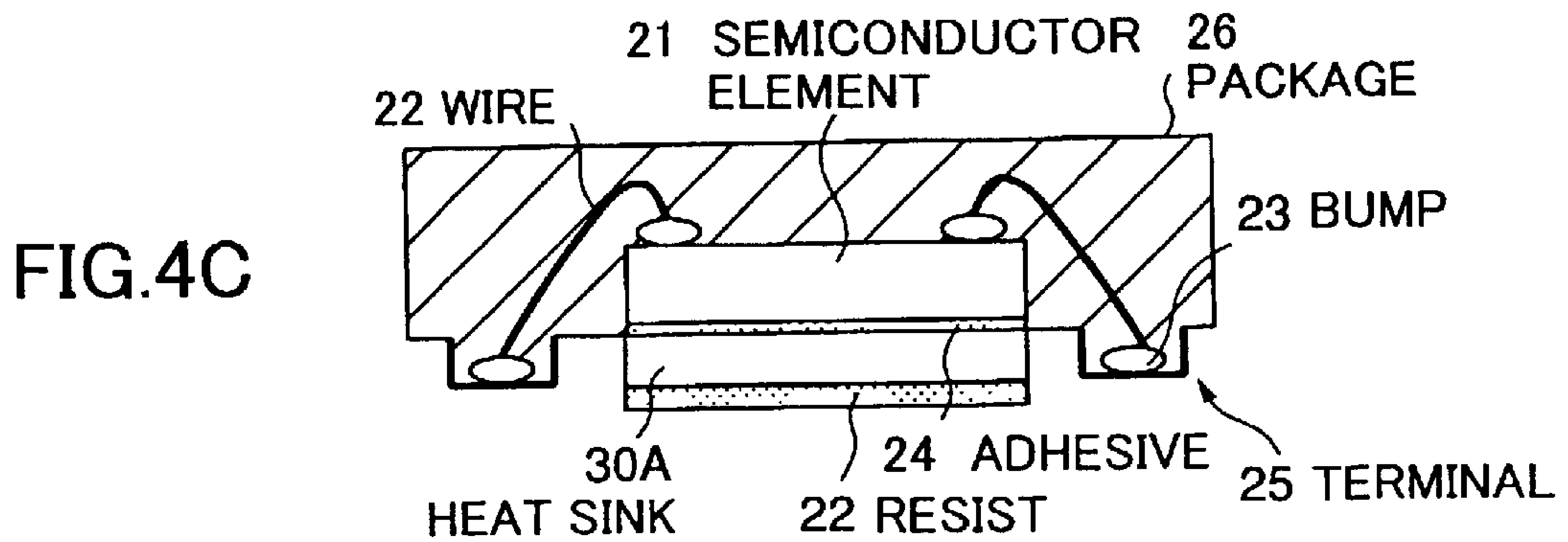


FIG.4D

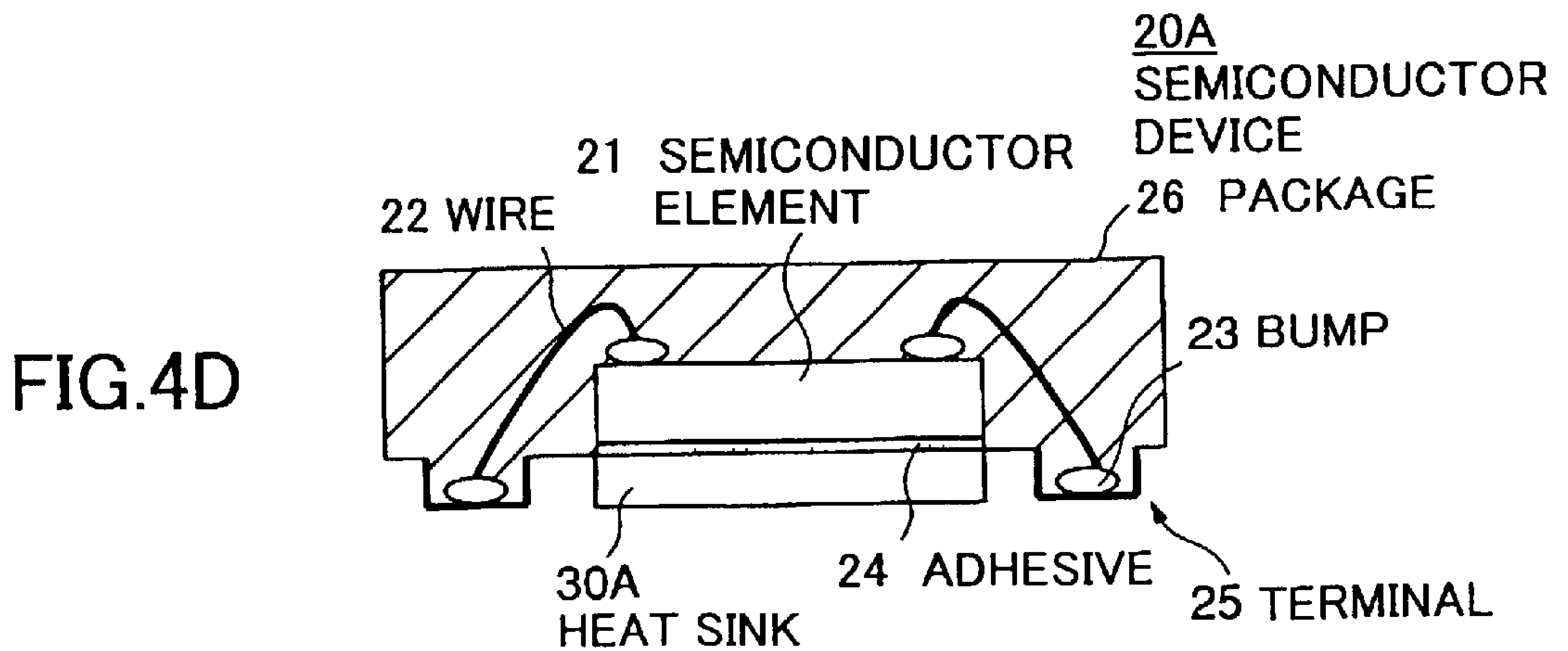


FIG.5

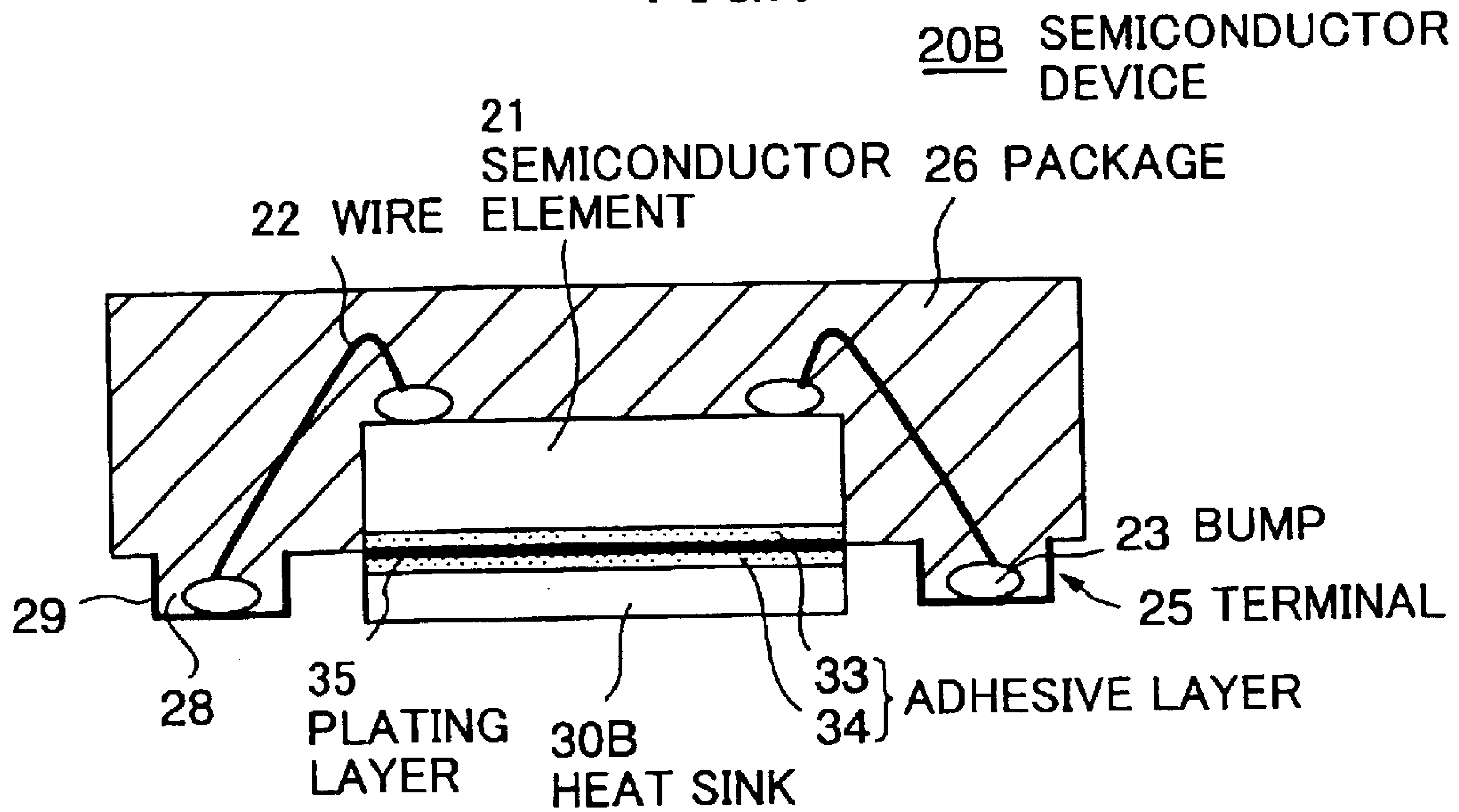


FIG.6

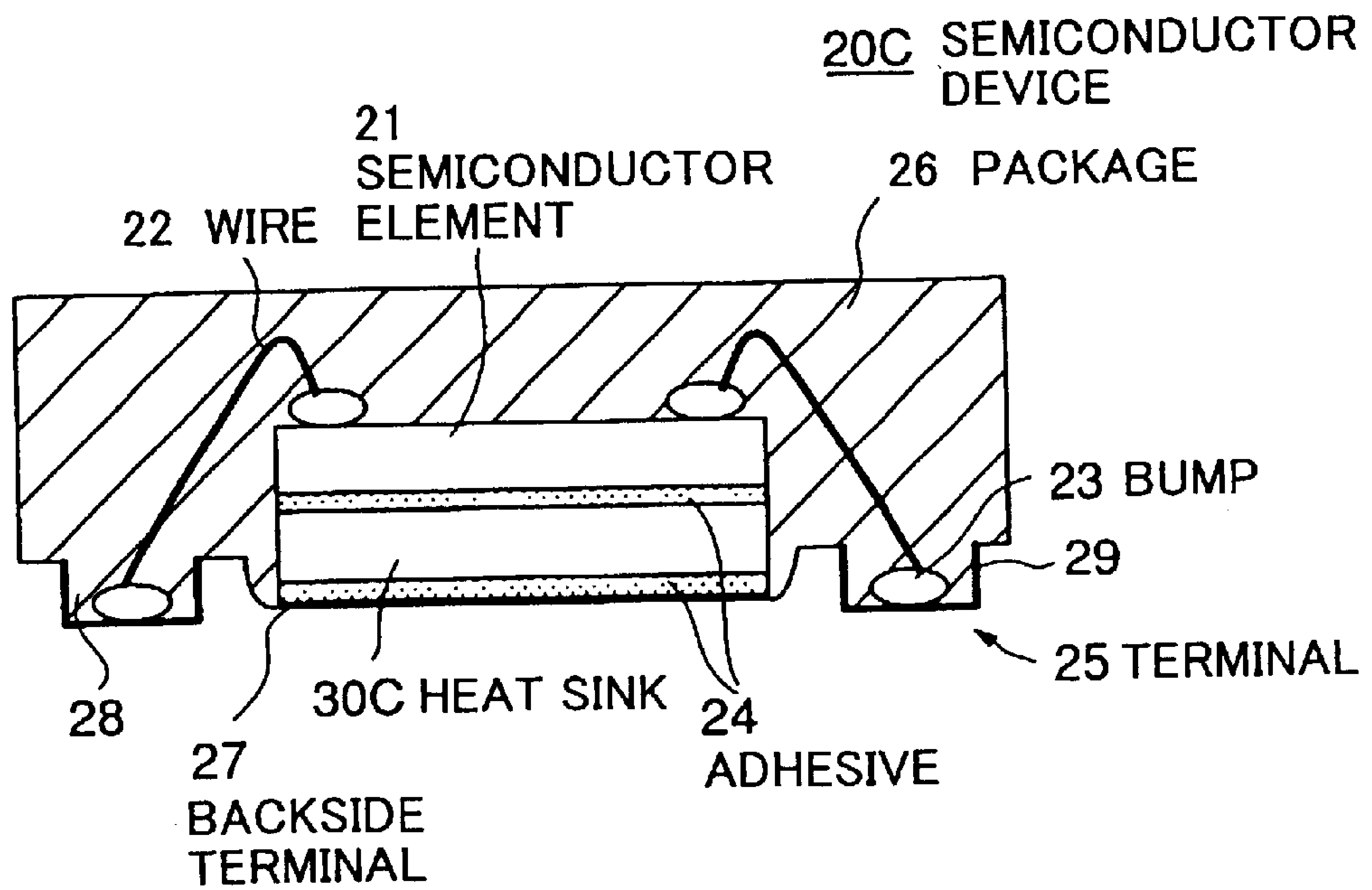


FIG.7

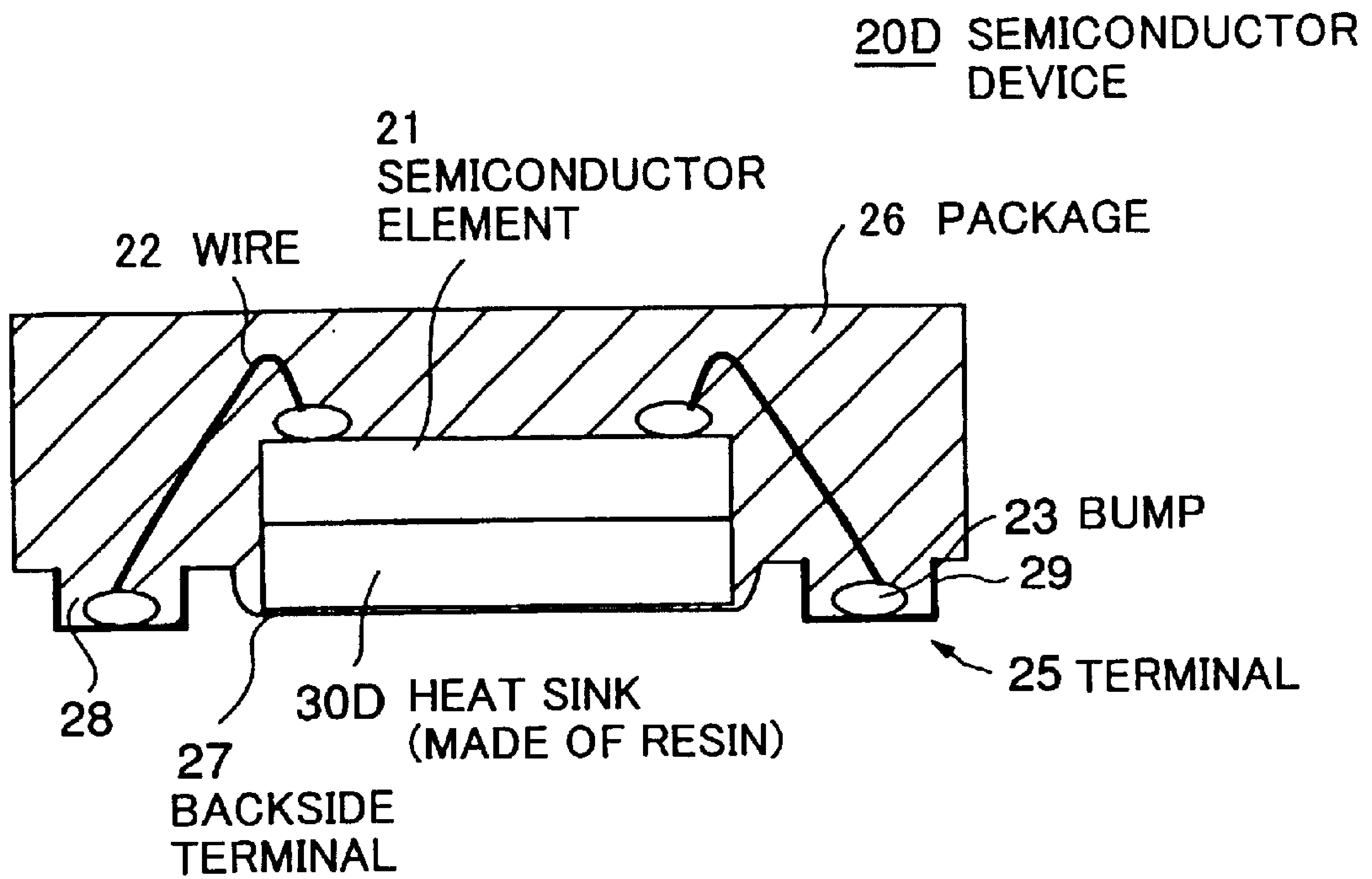


FIG.8

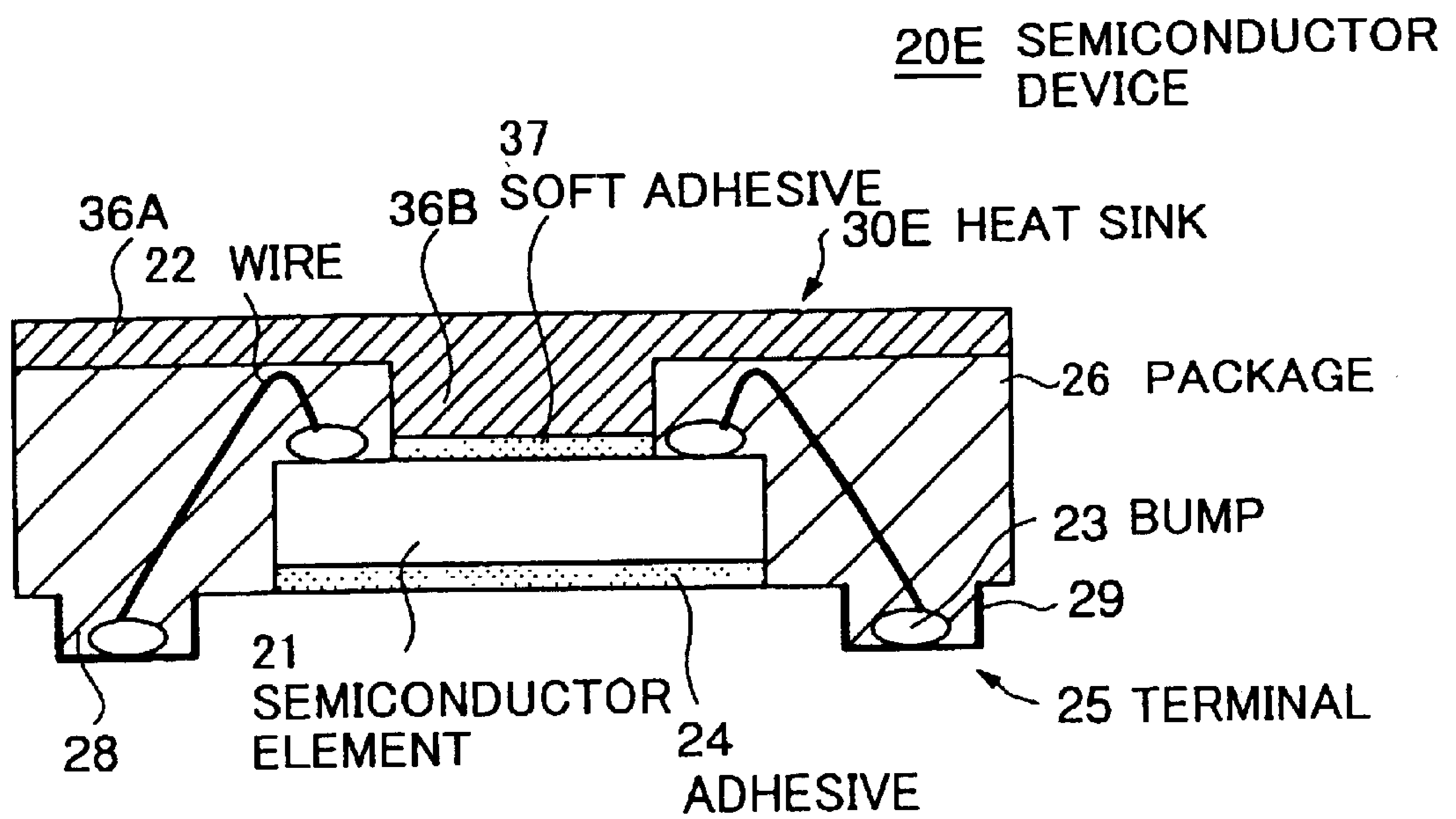


FIG.9

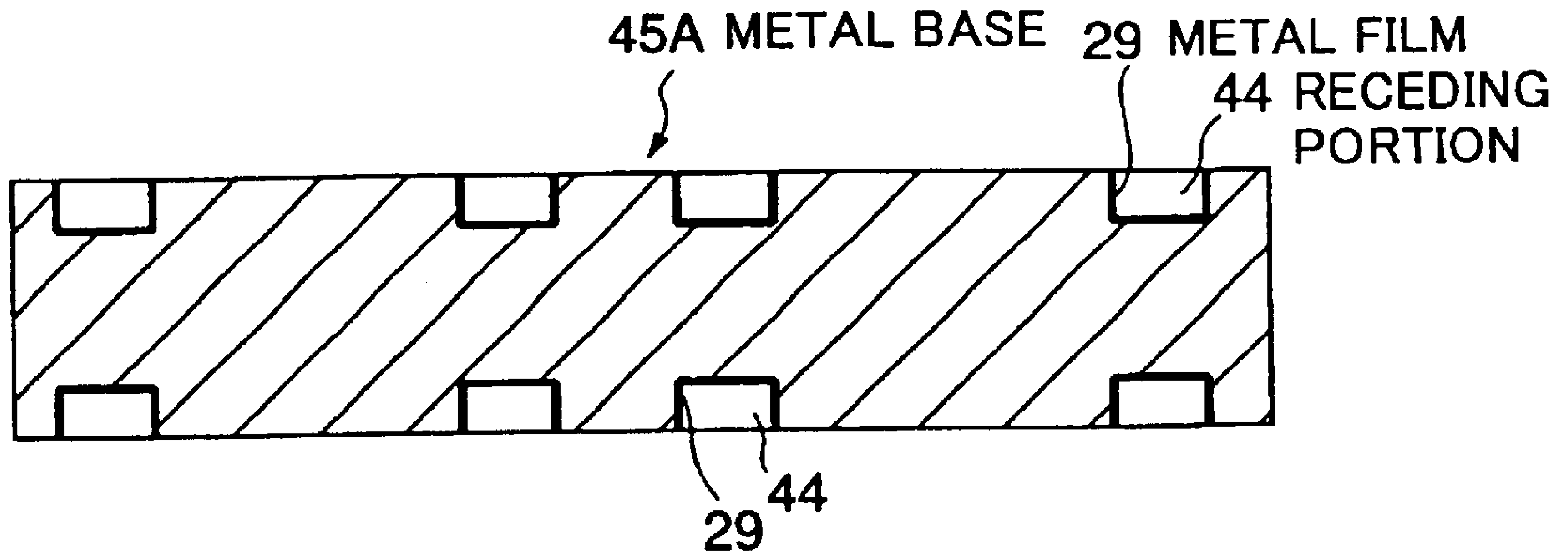


FIG.10

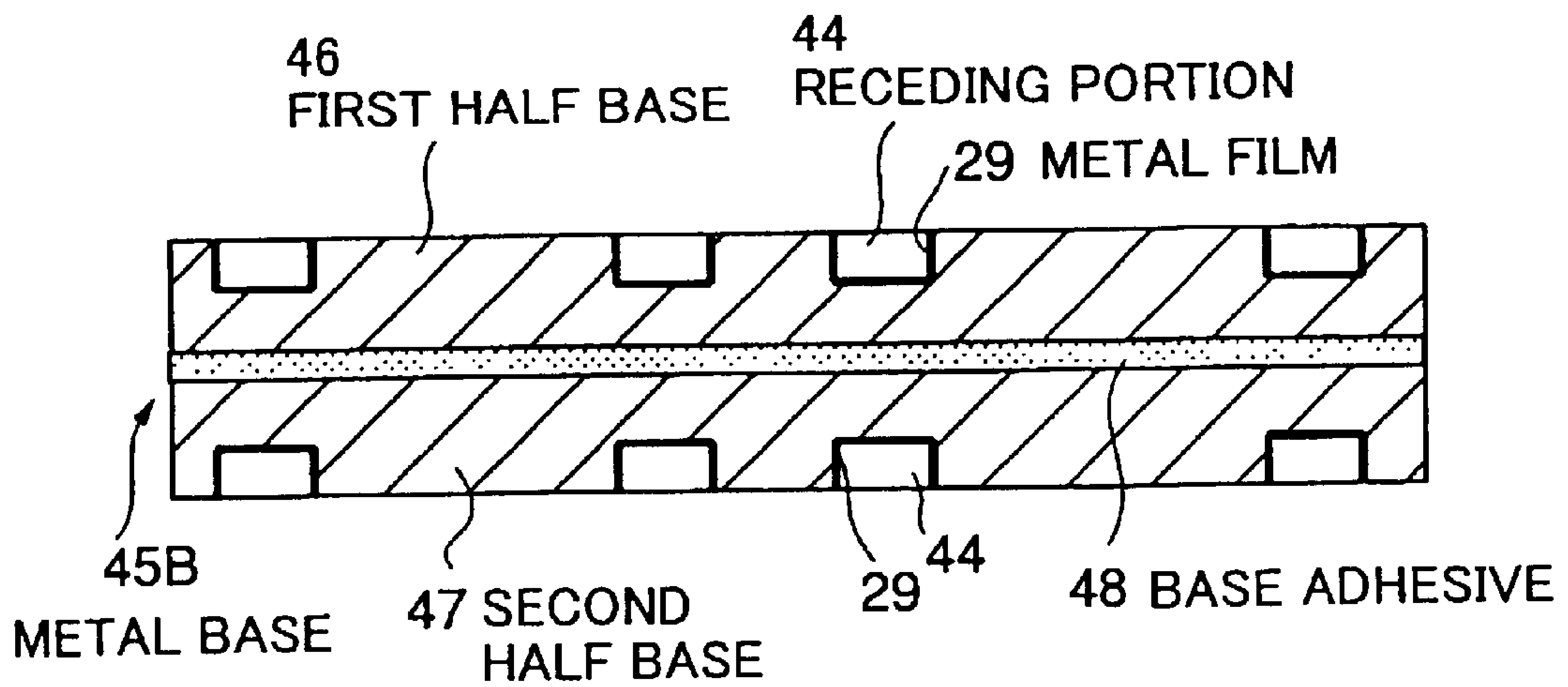


FIG.11

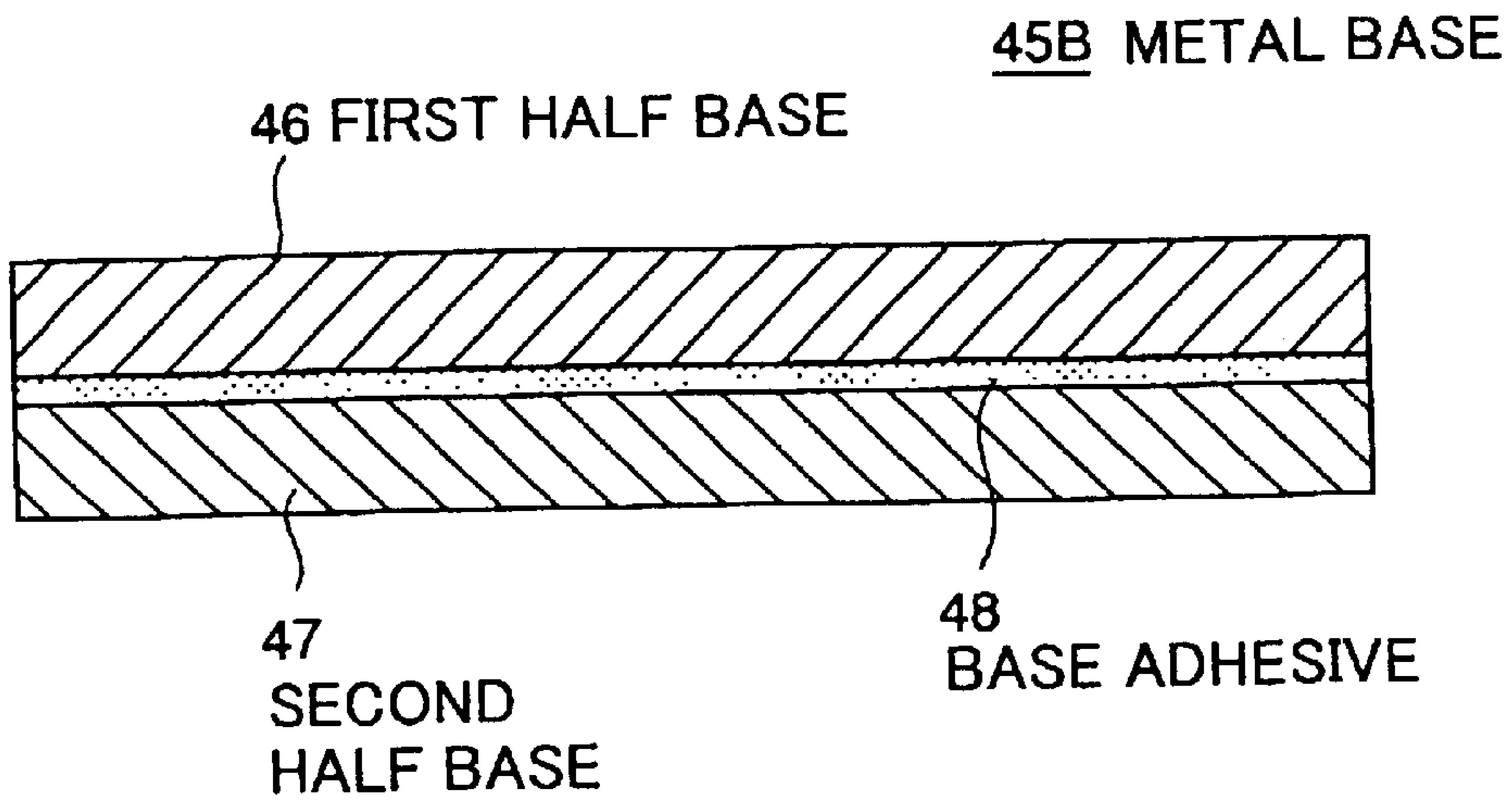


FIG.12

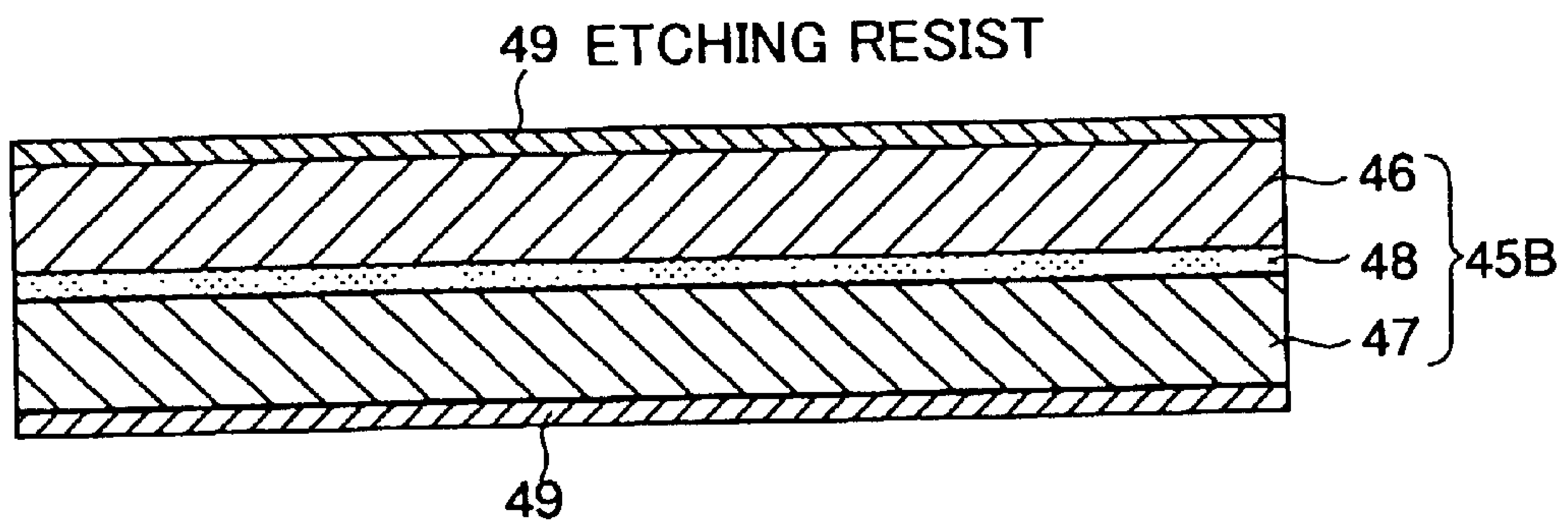


FIG.13

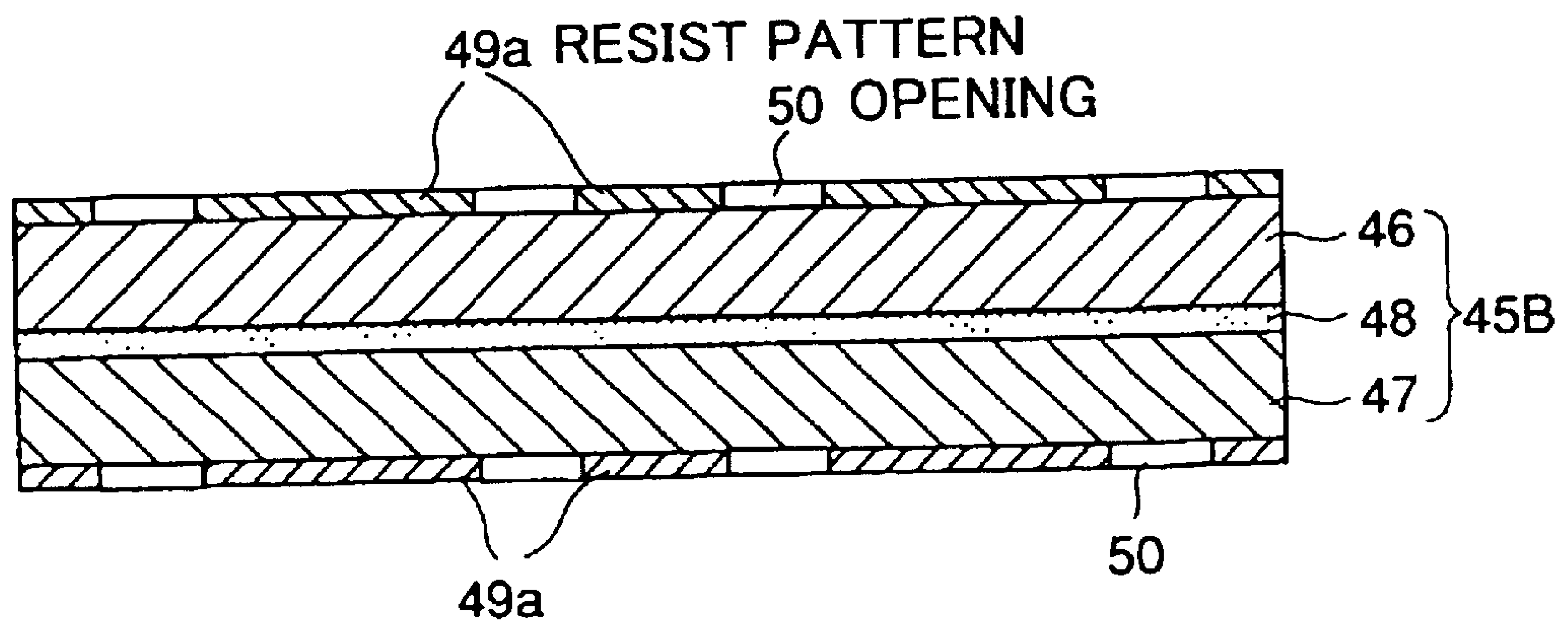


FIG.14

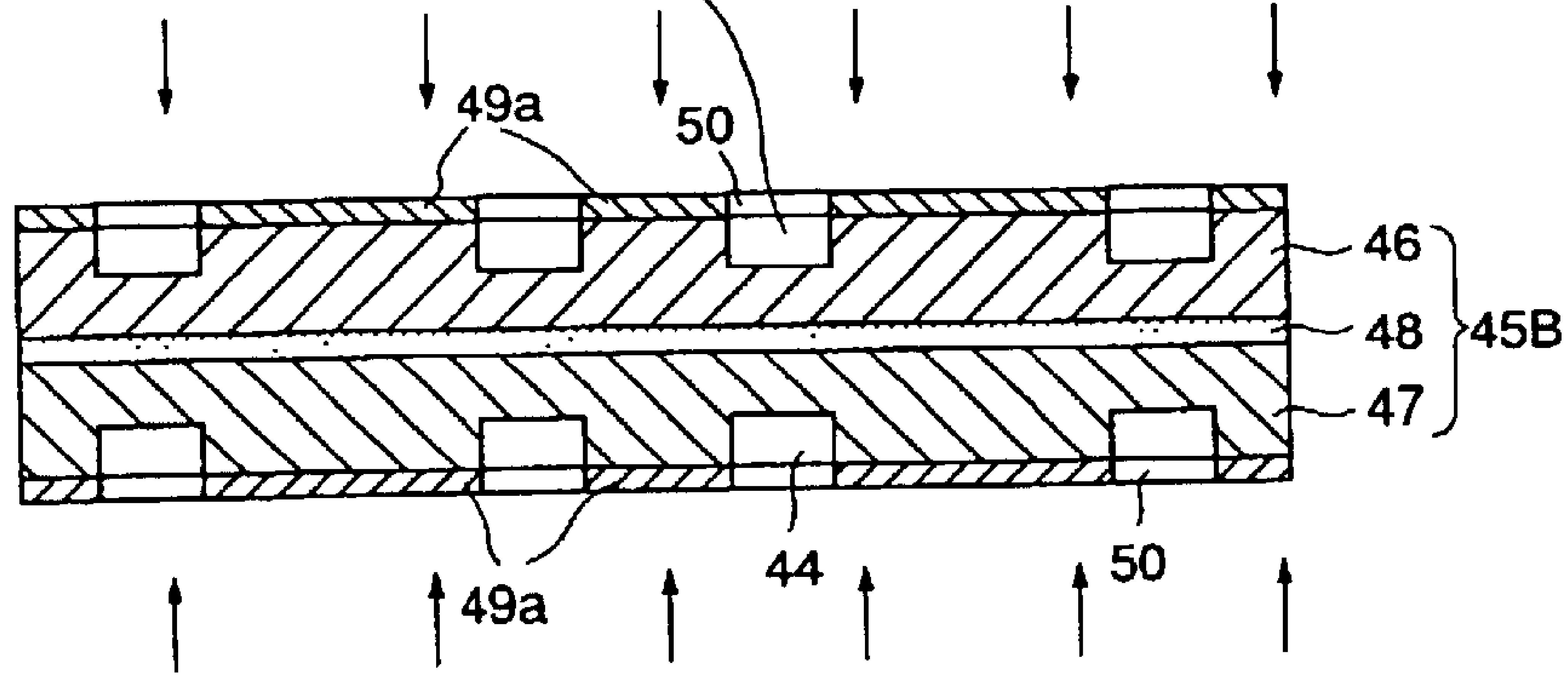


FIG.15

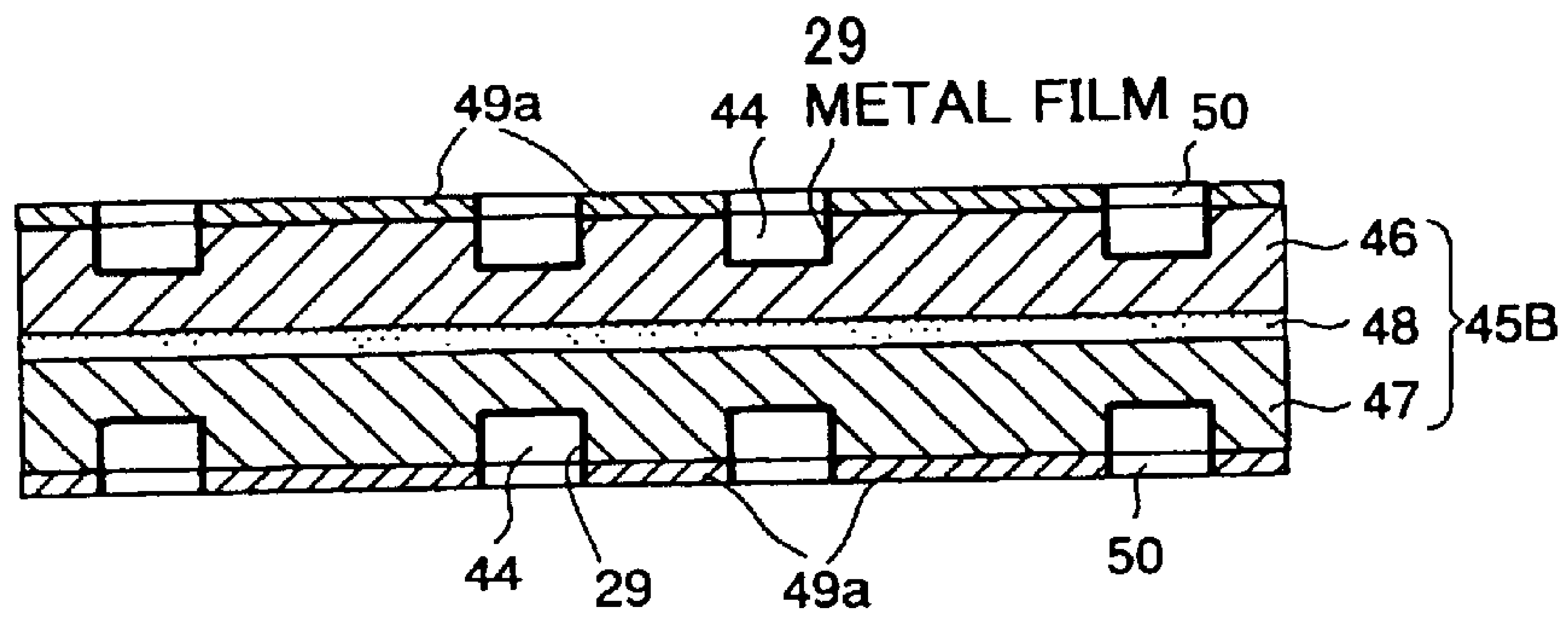


FIG.16

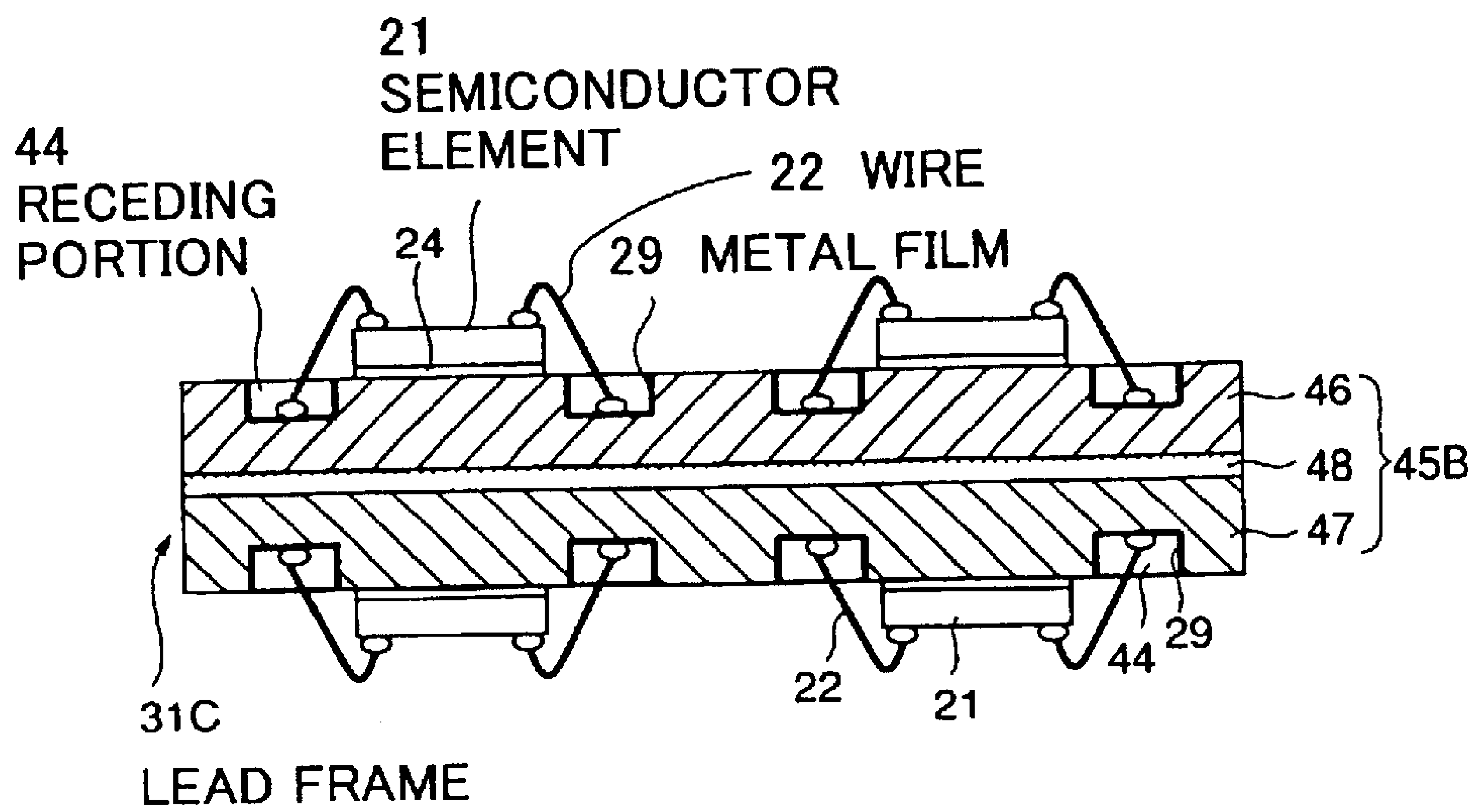


FIG.17

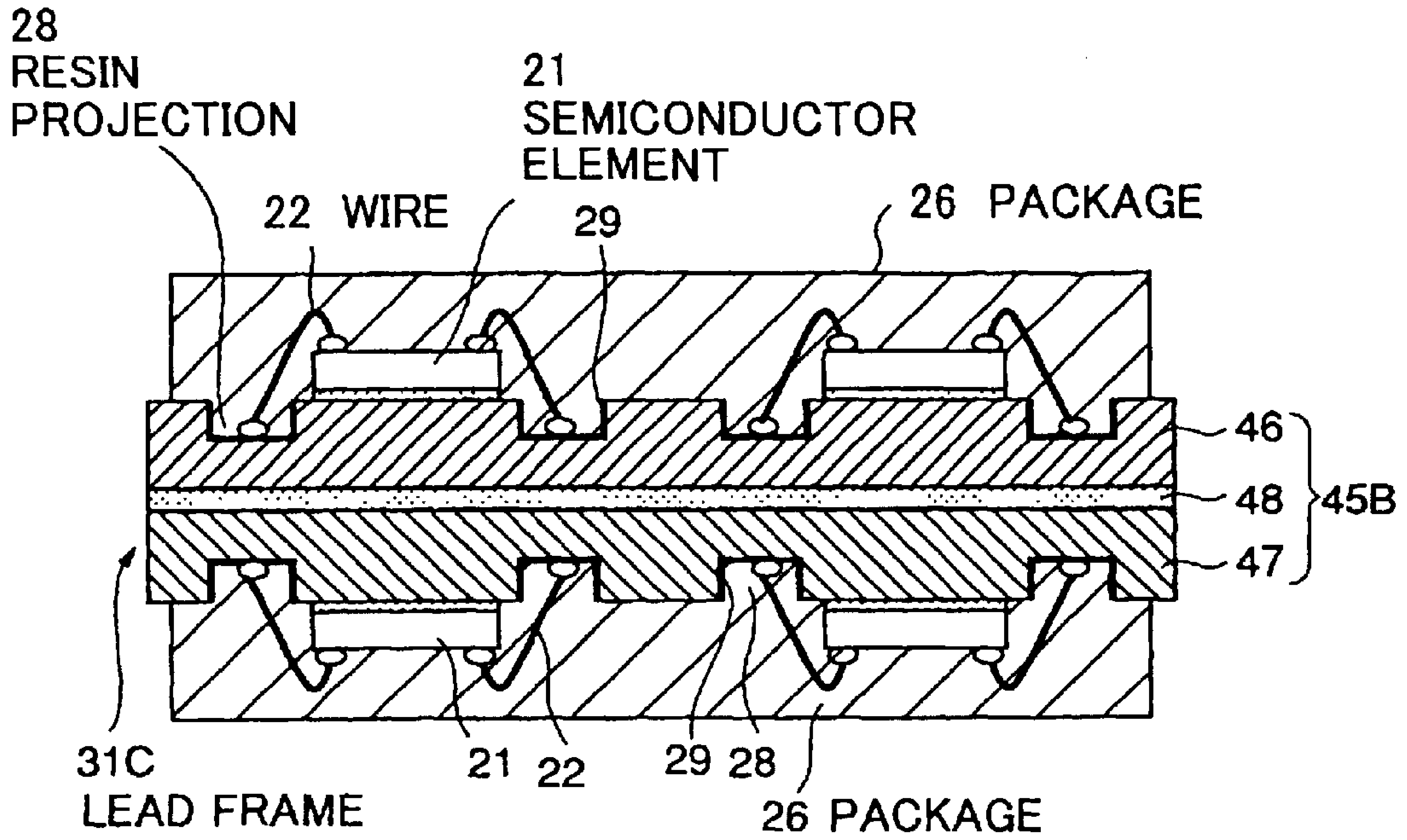
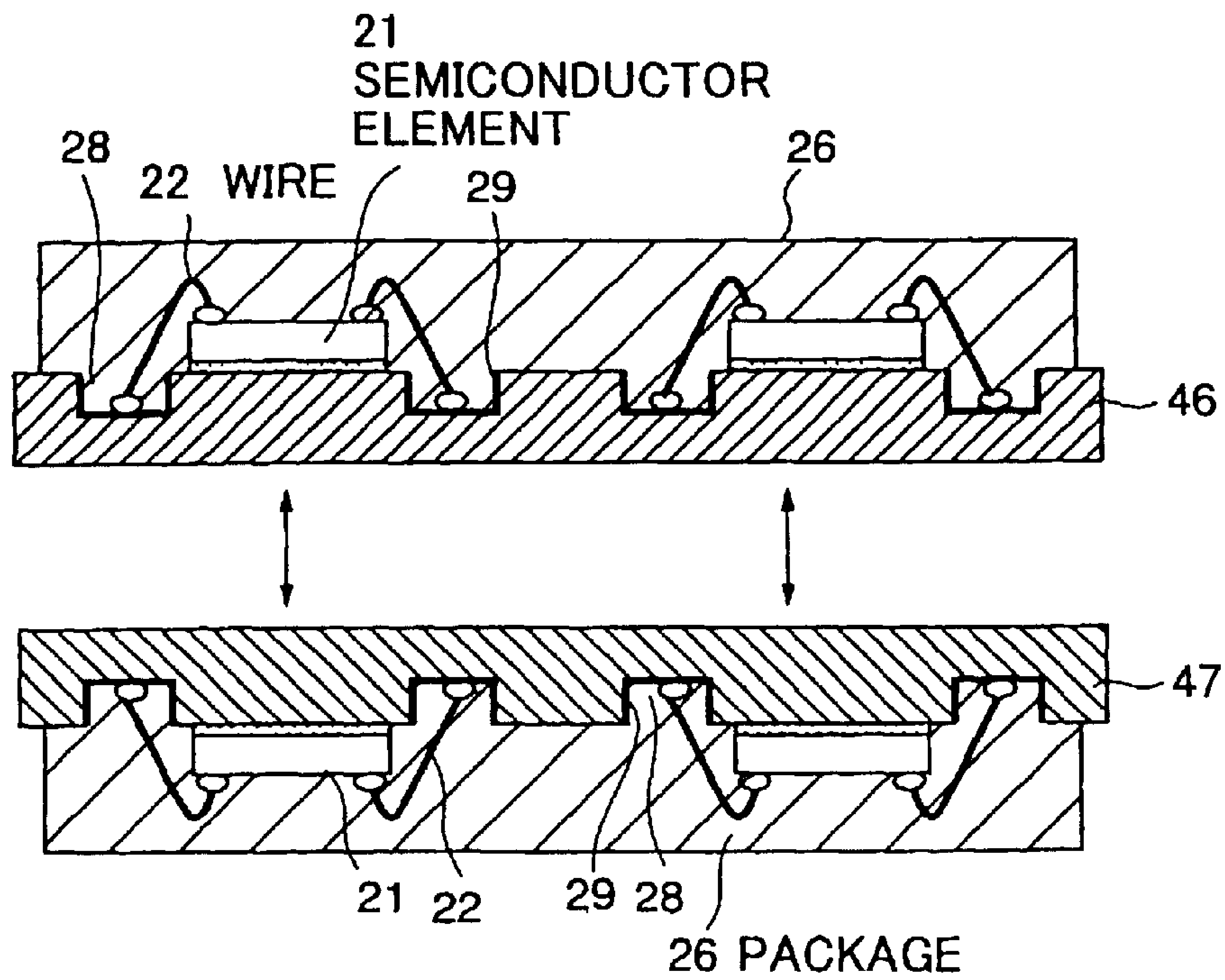


FIG.18



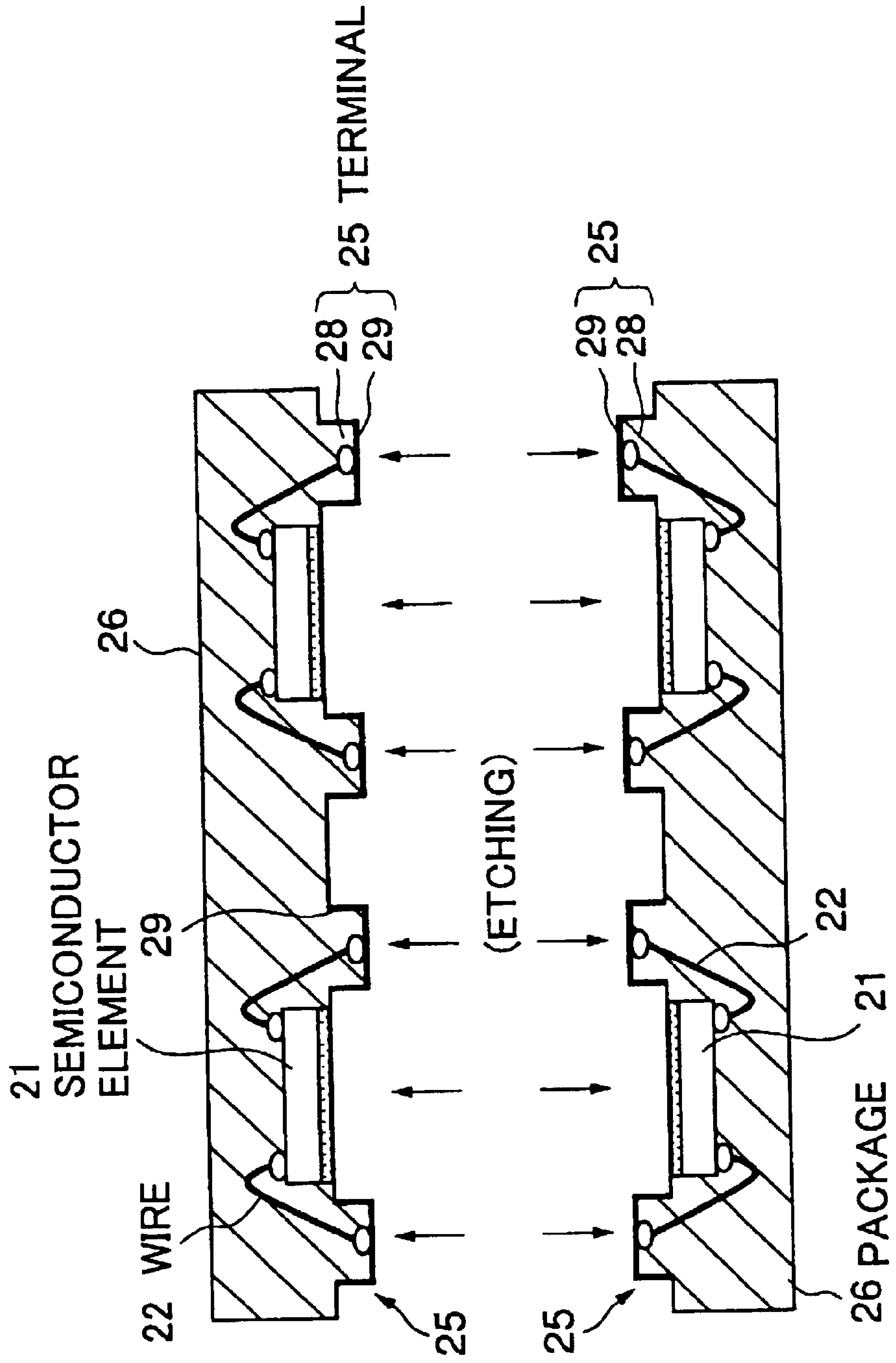


FIG.19
25 TERMINAL
28
29
25
29
28
26
21 SEMICONDUCTOR ELEMENT
29
(ETCHING)
22
21
22 WIRE
25
25
26 PACKAGE

FIG.20

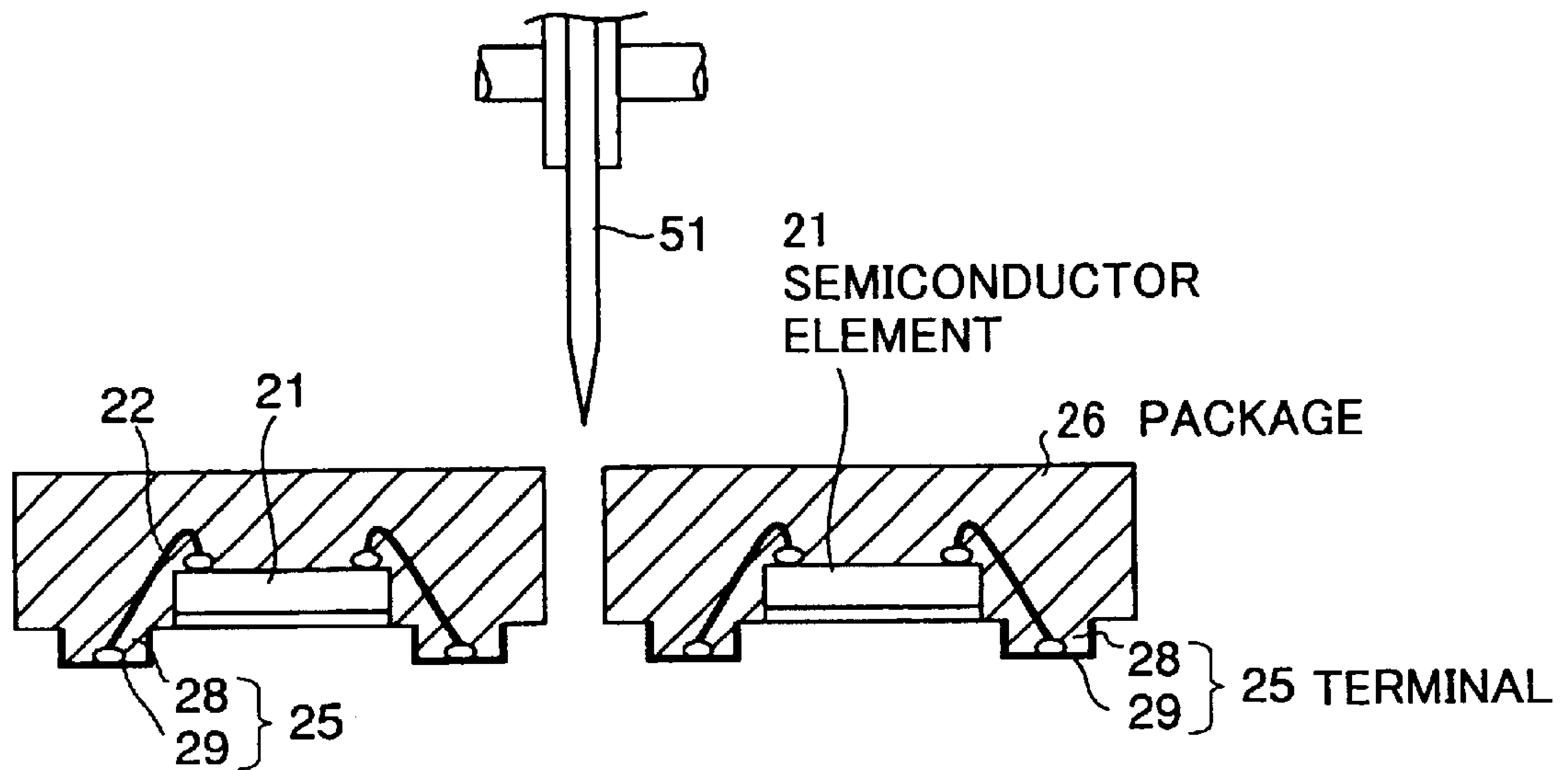
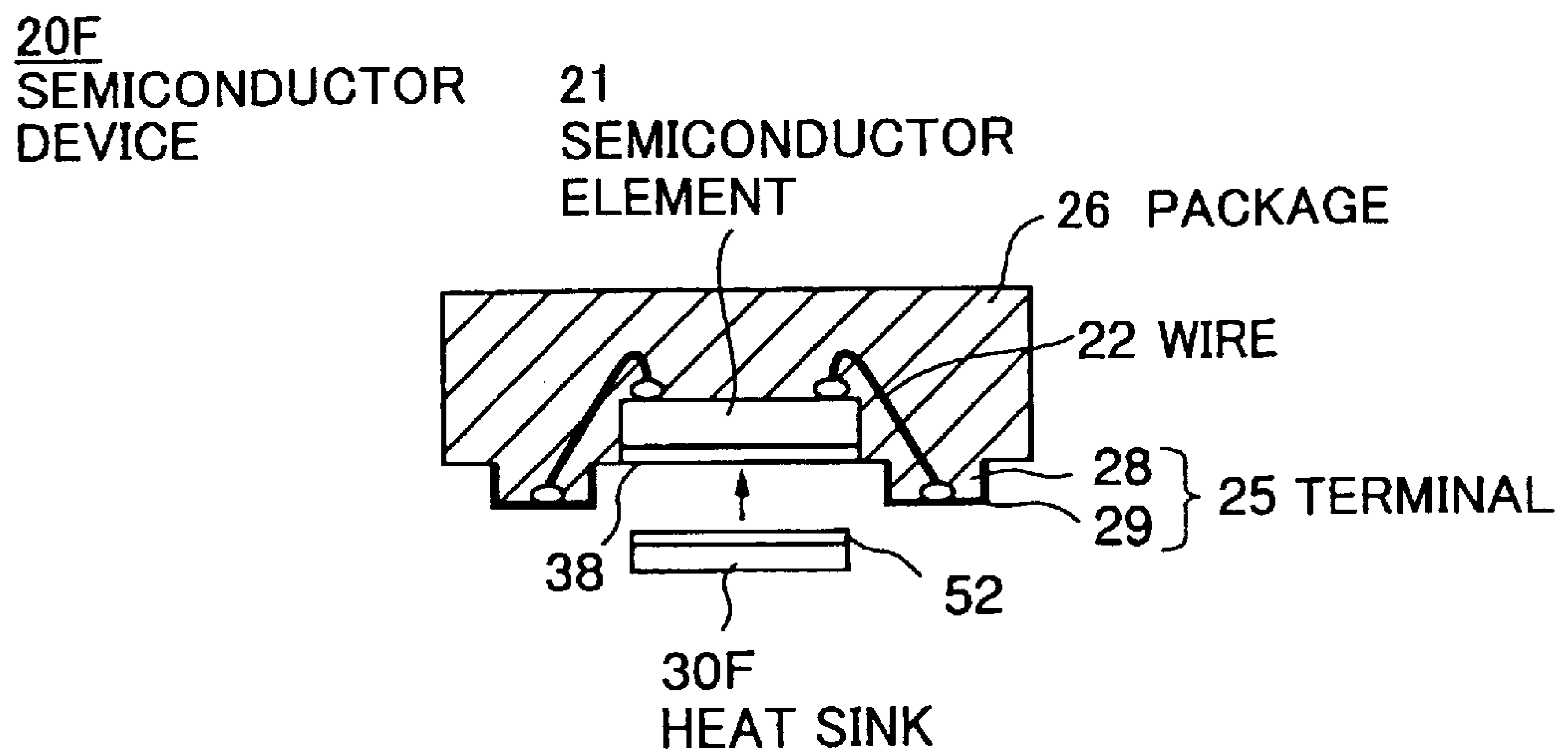


FIG.21



SEMICONDUCTOR DEVICE, METHOD OF MANUFACTURING SEMICONDUCTOR DEVICE, LEAD FRAME, METHOD OF MANUFACTURING LEAD FRAME, AND METHOD OF MANUFACTURING SEMICONDUCTOR DEVICE WITH LEAD FRAME

This application is a continuation of international application PCT/JP00/01433 filed on Mar. 9, 2000.

TECHNICAL FIELD

The present invention relates to a semiconductor device, a manufacturing method thereof, a lead frame, a manufacturing method thereof, and a manufacturing method of a semiconductor device using a lead frame, and more particularly, to a leadless surface-mount resin-sealing semiconductor device, a manufacturing method thereof, a lead frame, a manufacturing method thereof, and a manufacturing method of a semiconductor device using a lead frame.

Recently, as electronic apparatuses become smaller and highly functional, semiconductor devices provided in these electronic apparatuses also become smaller and thinner at a rapid pace. When semiconductor devices become smaller and thinner, it becomes difficult to efficiently dissipate heat generated in a semiconductor element.

Thus, a new structure to efficiently dissipate heat generated in a semiconductor element is desired even for semiconductor devices made smaller and thinner.

BACKGROUND ART

FIG. **1** and FIG. **2** show conventional semiconductor devices **10**A and **10**B.

Each of the semiconductor devices **10**A and **10**B shown in the respective figures has a considerably simple structure comprising a semiconductor element **11**, a wire **12**, a terminal **15**, a resin package **16** and so forth. A resin projection **18** protruding downward from a mount surface **16***a* of the resin package **16** is formed unitarily with each of the semiconductor devices **10**A and **10**B The resin projection **18** is coated with a metal film **19** so as to form the terminal **15**.

Additionally, in the semiconductor device **10**B shown in FIG. **2**, a backside terminal **17** is formed on the mount surface **16***a* of the resin package **16**. This backside terminal **17** is a conductive metal film as is the metal film **19**, and is so structured as to be electrically connected to a ground terminal on a mounting substrate (not shown in the figures) upon mounting the semiconductor device **10**B on the mounting substrate. Accordingly, in the mounting state, the backside terminal **17** functions as a shield member shielding the semiconductor element **11** so as to improve electric characteristics of the semiconductor device **10**B.

Since the semiconductor devices **10**A and **10**B structured as above are not provided with an inner lead and an outer lead as in an SSOP, an area for drawing around from the inner lead to the outer lead and an area of the outer lead per se become unnecessary so as to miniaturize the semiconductor devices **10**A and **10**B.

Additionally, a loading substrate (an interposer) for forming a solder ball, such as a BGA (Ball Grid Array), also becomes unnecessary so as to reduce costs of the semiconductor devices **10**A and **10**B. Further, the terminal **15** composed of the resin projection **18** and the metal film **19** exhibits a function equivalent to a solder ball in co-operation so as to obtain a mounting property similar to a semiconductor device of a BGA type.

By the way, as the semiconductor element **11** becomes highly dense recently, an amount of heat generated in the semiconductor element **11** tends to increase. However, since a coefficient of thermal conductivity of resin is low in a resin-sealing semiconductor device, a heat-dissipation characteristic becomes inferior.

Additionally, since the terminal **15** is structured by coating the resin projection **18** with the metal film **19** in the semiconductor devices **10**A and **10**B shown in FIG. **1** and FIG. **2**, an amount of heat dissipation from a mounting terminal is as small as a BGA having a solder ball as a mounting terminal and a QFP (Quad Flat Package) having a lead as a mounting terminal. Therefore, although the semiconductor devices **10**A and **10**B shown in FIG. **1** and FIG. **2** have the above-mentioned favorable characteristics, the semiconductor devices **10**A and **10**B have insufficient heat-dissipation characteristics so as to incur a problem that a malfunction is caused in the semiconductor element **11** by the generated heat.

DISCLOSURE OF INVENTION

It is a general object of the present invention to provide an improved and useful semiconductor device, a manufacturing method thereof, a lead frame, a manufacturing method thereof, and a manufacturing method of a semiconductor device using a lead frame in which the above-mentioned problems are eliminated.

A more specific object of the present invention is to provide a semiconductor device capable of efficiently dissipating heat generated in a semiconductor element, a manufacturing method thereof, a lead frame, a manufacturing method thereof, and a manufacturing method of a semiconductor device using a lead frame.

In order to achieve this object, the present invention, which is a semiconductor device comprising a semiconductor element, a resin package sealing the foregoing semiconductor element, a plurality of resin projections formed on a mount side of the foregoing resin package so as to protrude thereon, a metal film provided on the foregoing resin projection, and a wire electrically connecting an electrode pad on the foregoing semiconductor element and the foregoing metal film to each other, is characterized in that a heat-dissipation member is provided opposite the foregoing semiconductor element so as to dissipate heat generated from the foregoing semiconductor element, and a projection amount of the foregoing heat-dissipation member from the foregoing mount surface is arranged to be equal to or smaller than a projection amount of the foregoing resin projection including the foregoing metal film.

According to the present invention, the heat-dissipation member dissipating heat generated from the semiconductor element is provided opposite the semiconductor element such that the heat generated in the semiconductor element is dissipated at the heat-dissipation member. Therefore, the semiconductor element can be cooled efficiently so as to prevent a malfunction from occurring in the semiconductor element.

Additionally, since the projection amount of the heat-dissipation member from the mount surface is arranged to be equal to or smaller than the projection amount of the resin projection including the metal film, the heat-dissipation member does not thwart a joining of the metal film and a mounting substrate upon mounting the semiconductor device.

Additionally, in the above-mentioned semiconductor device, the present invention is characterized in that the

foregoing heat-dissipation member is a metal plate formed of a lead-frame material.

According to the present invention, the heat-dissipation member is provided as the metal plate formed of the lead-frame material so as to obtain an excellent heat-dissipation characteristic because the lead-frame material has a high coefficient of thermal conductivity.

Additionally, in the above-mentioned semiconductor device, the present invention is characterized in that at least one metal layer is provided between the foregoing semiconductor element and the foregoing heat-dissipation member, and the foregoing heat-dissipation member is fixed to the foregoing metal layer by bonding.

According to the present invention, at least one metal layer is provided between the semiconductor element and the heat-dissipation member, and the heat-dissipation member is fixed to the metal layer by bonding so that a material having an excellent adhesiveness can be used as the metal layer so as to fix the heat-dissipation member firmly. In addition, since the metal layer per se has a thermal conductivity, the heat generated in the semiconductor element can be efficiently transferred by thermal conduction to the heat-dissipation member.

Additionally, in order to achieve the above-mentioned object, the present invention, which is a semiconductor device comprising a semiconductor element, a resin package sealing this semiconductor element, a plurality of resin projections formed in a peripheral form on a mount side of this resin package so as to protrude thereon, a metal film provided on this resin projection, a backside terminal formed inside positions on the foregoing mount side at which the foregoing resin projections are provided so as to protrude thereat, a wire electrically connecting an electrode pad on the foregoing semiconductor element and the foregoing metal film to each other, is characterized in that a heat-dissipation member is provided between the foregoing semiconductor element and the foregoing backside terminal.

According to the present invention, the heat-dissipation member is provided between the semiconductor element and the backside terminal so that the heat generated in the semiconductor element is first transferred by thermal conduction to the heat-dissipation member, and thereafter is transferred by thermal conduction to the backside terminal so as to be emitted to outside. In this course, since the backside terminal is joined to the mounting substrate on which the semiconductor element is mounted, the heat generated in the semiconductor element is transferred by thermal conduction to the mounting substrate, and is dissipated also at this mounting substrate. Thus, providing the heat-dissipation member between the semiconductor element and the backside terminal enables an increase in a heat-dissipation capacity so as to perform an efficient heat-dissipation process.

Additionally, in the above-mentioned semiconductor device, the present invention is characterized in that the foregoing semiconductor element is placed on the foregoing heat-dissipation member.

According to the present invention, the semiconductor element is placed directly on top of the heat-dissipation member so that the heat generated in the semiconductor element can be directly dissipated to the heat-dissipation member so as to improve a heat-dissipation efficiency. Also, the heat-dissipation member can be used as a substrate on which the semiconductor element is mounted.

Additionally, in order to achieve the above-mentioned object, the present invention, which is a manufacturing method of the above-mentioned semiconductor device, is characterized by comprising a lead frame forming step of forming a lead frame by preparing a substrate formed of the lead-frame material, forming a receding portion at a position in the foregoing substrate corresponding to a position at which the foregoing resin projection is formed, and coating inside of the foregoing receding portion with the foregoing metal film, an element mounting step of mounting the foregoing semiconductor element on the foregoing lead frame, and electrically connecting the foregoing semiconductor element ad the foregoing metal film to each other by the foregoing wire, a sealing step of forming the foregoing resin package sealing at least the foregoing semiconductor element and the foregoing wire, a first lead frame removing step of removing the foregoing lead frame so that a thickness of the foregoing lead frame becomes equal to or smaller than a height of the foregoing resin projection including the foregoing metal film from the foregoing mount surface, and a second lead frame removing step of providing a resist material at a predetermined position on the foregoing lead frame at which to form the foregoing heat-dissipation member, and thereafter, removing the foregoing lead frame on which the foregoing resist is not provided so as to form the foregoing heat-dissipation member.

In the present invention, the lead frame formed in the lead frame forming step is removed after the element mounting step and the sealing step are finished. In this course, firstly, the first lead frame removing step is performed so as to perform a removing process of the lead frame such that the thickness of the lead frame becomes equal to or smaller than the height of the resin projection including the metal film from the mount surface. At the point of completion of this removing process, the metal film shares substantially the same plane as the lead frame, or protrudes slightly from the lead frame.

Next, the second lead frame removing step is performed so as to provide the resist material at the predetermined position on the lead frame at which to form the heat-dissipation member, and thereafter, remove the lead frame on which this resist is not provided. Thereby, the position on the lead frame at which the resist material is provided remains on the mount surface so that this portion becomes the heat-dissipation member.

Thus, utilizing the lead frame used upon manufacturing the semiconductor device, a part of the lead frame is caused to remain, in the first and second lead frame removing steps, so that the part becomes the heat-dissipation member; therefore, manufacturing steps can be simplified, compared to a method of forming a heat-dissipation member from a material different from the lead frame. In addition, a new manufacturing facility for forming the heat-dissipation member is also unnecessary so that facility costs do not increase.

Additionally, in order to achieve the above-mentioned object, the present invention, which is a lead frame used upon manufacturing a semiconductor device comprising a semiconductor device, a resin package sealing the foregoing semiconductor device, a resin projection formed on a mount surface of the foregoing resin package so as to protrude thereon, a metal film provided on the foregoing resin projection, and connecting means for electrically connecting an electrode pad on the foregoing semiconductor element and the foregoing metal film to each other, is characterized in that a receding portion formed at a position in a base corresponding to a position at which the foregoing resin projection is formed, the receding portion having the foregoing metal film formed therein, is formed at both surfaces of the foregoing base.

Additionally, in the above-mentioned lead frame, the present invention is characterized in that the foregoing metal film is a four-layer structured film of a solder layer, a nickel (Ni) layer, a palladium (Pd) layer, and a gold (Au) layer, from an inner layer, or a four-layer structured film of a palladium (Pd) layer, a nickel (Ni) layer, a palladium (Pd) layer, and a gold (Au) layer, from the inner layer.

Additionally, in the above-mentioned lead frame, the present invention is characterized in that the foregoing base is composed of first and second half bases at one surface of each of which the foregoing receding portion is formed, and surfaces of the foregoing first and second half bases at which the foregoing receding portion is not formed are joined to each other.

Additionally, in order to achieve the above-mentioned object, the present invention, which is a manufacturing method of the above-mentioned lead frame, is characterized by comprising a resist applying step of applying etching resists on both surfaces of the base, a resist pattern forming step of forming predetermined resist patterns by removing portions of the foregoing etching resists corresponding to the foregoing receding-portion forming positions, an etching step of forming the receding portions at the foregoing receding-portion forming positions at both surfaces of the foregoing base by using the resist patterns as masks, a metal-film forming step of forming the foregoing metal films in the receding portions formed in the foregoing etching step, and a resist removing step of removing the foregoing etching resists.

Further, in order to achieve the above-mentioned object, the present invention, which is a manufacturing method of a semiconductor device by using the above-mentioned lead frame, is characterized by comprising an element mounting step of mounting the semiconductor element on the foregoing lead frame, a connecting step of electrically connecting an electrode pad formed on the foregoing semiconductor element and the foregoing metal film formed in the foregoing lead frame to each other, a sealing step of forming a resin on the foregoing lead frame, the resin sealing the foregoing semiconductor device, so as to form the resin package, a dividing step of dividing the foregoing lead frame into the foregoing first half base and the foregoing second half base, and a separating step of separating the foregoing resin package together with the foregoing metal film from the foregoing first and second half bases.

According to the lead frame, the manufacturing method of the lead frame, and the manufacturing method of a semiconductor device by using the lead frame, of each of the above-mentioned inventions, a lead-frame cost required for manufacturing one semiconductor device can be reduced, and thus a manufacturing cost can be reduced. In addition, since a multitude of the semiconductor devices can be formed all at one time, a manufacturing efficiency can be improved.

BRIEF DESCRIPTION OF DRAWINGS

Other objects, features and advantages of the present invention will become more apparent from the following detailed description when read in conjunction with the accompanying drawings.

FIG. **1** is a sectional view of a semiconductor device as a conventional example.

FIG. **2** is a sectional view of a semiconductor device as a conventional example.

FIG. **3** is a sectional view of a semiconductor device according to a first embodiment of the present invention.

FIG. **4** is an illustration used for explaining a manufacturing method of the semiconductor device according to the first embodiment of the present invention.

FIG. **5** is a sectional view of a semiconductor device according to a second embodiment of the present invention.

FIG. **6** is a sectional view of a semiconductor device according to a third embodiment of the present invention.

FIG. **7** is a sectional view of a semiconductor device according to a fourth embodiment of the present invention.

FIG. **8** is a sectional view of a semiconductor device according to a fifth embodiment of the present invention.

FIG. **9** is an illustration showing a lead frame applicable to a manufacturing method of a semiconductor device according to a second embodiment of the present invention.

FIG. **10** is an illustration showing a lead frame applicable to a manufacturing method of a semiconductor device according to a second embodiment of the present invention.

FIG. **11** is an illustration used for explaining one embodiment of a manufacturing method of the lead frame (a step of joining half bases).

FIG. **12** is an illustration used for explaining the embodiment of the manufacturing method of the lead frame (a resist applying step).

FIG. **13** is an illustration used for explaining the embodiment of the manufacturing method of the lead frame (a resist pattern forming step).

FIG. **14** is an illustration used for explaining the embodiment of the manufacturing method of the lead frame (an etching step).

FIG. **15** is an illustration used for explaining the embodiment of the manufacturing method of the lead frame (a metal-film forming step).

FIG. **16** is an illustration used for explaining the manufacturing method of a semiconductor device according to the second embodiment of the present invention (an element mounting step, a connecting step).

FIG. **17** is an illustration used for explaining the manufacturing method of a semiconductor device according to the second embodiment of the present invention (a sealing step).

FIG. **18** is an illustration used for explaining the manufacturing method of a semiconductor device according to the second embodiment of the present invention (a dividing step).

FIG. **19** is an illustration used for explaining the manufacturing method of a semiconductor device according to the second embodiment of the present invention (a separating step).

FIG. **20** is an illustration used for explaining the manufacturing method of a semiconductor device according to the second embodiment of the present invention (a severing step).

FIG. **21** is an illustration used for explaining the manufacturing method of a semiconductor device according to the second embodiment of the present invention (a step of joining a heat sink).

BEST MODE FOR CARRYING OUT THE INVENTION

Hereinbelow, a description will be given, with reference to the drawings, of embodiments according to the present invention.

FIG. **3** shows a semiconductor device **20**A according to a first embodiment of the present invention. This figure shows

a state where the semiconductor device **20**A is mounted on a mounting substrate **40**. This semiconductor device **20**A mainly comprises a semiconductor element **21**, a resin package **26** (hereinafter referred to as a package), and a metal film **29**.

The semiconductor element **21** is arranged faceup, and a plurality of electrode pads (not shown in the figure) are formed on an upper surface of the semiconductor element **21**. Additionally, an adhesive **24** used upon mounting on a hereinafter-described lead frame **31** exists on an under surface of the semiconductor element **21**.

The package **26** is formed by transfer-molding (potting is also possible) an epoxy resin, for example, and a resin projection **28** is formed unitarily at a predetermined position on a mount surface **38** of the package **26**. This resin projection **28** is so formed as to protrude downward from the mount surface **38** of the package **26**.

In addition, the resin projection **28** is provided along an outer periphery of the mount surface **38** so as to be arranged in a so-called peripheral form. Accordingly, the resin projection **28** is not formed at a central part of the mount surface **38**. Besides, a pitch of arranging this resin projection **28** can be made approximately 0.8 mm, for example.

The metal film **29** has a structure including a single layer or a lamination of a plurality of conductive films, and is so formed as to cover the resin projection **28** formed on the package **26**. A wire **22** is provided between this metal film **29** and the above-mentioned electrode pad of the semiconductor element **21**, whereby the metal film **29** and the semiconductor element **21** are electrically connected to each other.

Further, a heat sink **30**A (a heat-dissipation member) is provided at a central position on the mount surface **38** so as to oppose the semiconductor element **21**. As mentioned above, the resin projection **28** is arranged on the mount surface **38** in a peripheral form, and thus, the resin projection **28** is not formed at the central part of the mount surface **38**. The heat sink **30**A is provided at this central area on the mount surface **38** at which the resin projection **28** is not formed.

The heat sink **30**A is a metal plate, and is formed of a lead-frame material (such as an iron alloy or a copper alloy). This lead-frame material generally has a high coefficient of thermal conductivity; thus, the heat sink **30**A exhibits an excellent heat-dissipation characteristic Additionally, a projection amount (a downward projection amount in the figure) of the heat sink **30**A from the mount surface **38** is set substantially equal to or slightly smaller than a projection amount of a terminal **25** (a projection amount of the resin projection **28** including the metal film **29**) from the mount surface **38**.

The semiconductor device **20**A structured as above does not require an inner lead and an outer lead as does a conventional SSOP; thus, an area for drawing around from the inner lead to the outer lead and an area of the outer lead per se become unnecessary so as to miniaturize the semiconductor device **20**A.

Additionally, a loading substrate does not to be used for forming a solder ball, such as a conventional BGA; thus, a cost of the semiconductor device **20**A can be reduced. Further, the resin projection **28** and the metal film **29** cooperatively exhibit a function equivalent to a solder ball of a semiconductor device of a BGA type so as to improve a mounting property.

Subsequently, a description will be given of a heat-dissipation characteristic of the semiconductor device **20**A in the state where the semiconductor device **20**A is mounted on the mounting substrate **40**.

The semiconductor device **20**A is mounted on the mounting substrate **40** by using solders **42**. Connection terminals **41**A and **41**B are formed beforehand on the mounting substrate **40**. Among these, the connection terminal **41**A is formed at a position corresponding to an arrangement position of the terminal **25** formed on the semiconductor device **20**A, and the connection terminal **41**B is formed at a position opposing the heat sink **30**A provided on the semiconductor device **20**A.

Thus, after a solder paste is applied on each of the connection terminals **41**A and **41**B of the mounting substrate **40**, the semiconductor device **20**A is positioned on the mounting substrate **40** such that the terminal **25** is positioned on the connection terminal **41**A, and that the heat sink **30**A is positioned on the connection terminal **41**B; and the semiconductor device **20**A is provisionally attached on the mounting substrate **40**. Subsequently, the mounting substrate **40** in a state where the semiconductor device **20**A is provisionally attached by the solder paste is caused to flow into a reflow furnace so as to melt the solder, whereby the terminal **25** is joined to the connection terminal **41**, and the heat sink **30**A is joined to the connection terminal **41**B, with the solders **42** therebetween, so that the semiconductor device **20**A is mounted on the mounting substrate **40**, in the state as shown in FIG. **3**.

Besides, upon this mounting, since the projection amount of the heat sink **30**A from the mount surface **38** is set equal to or smaller than the projection amount of the terminal **25**, the heat sink **30**A does not thwart the joining of the terminal **25** (the metal film **29**) and the mounting substrate **40** in mounting the semiconductor device **20**A.

By the way, as mentioned above, as the semiconductor element **21** becomes highly dense recently, an amount of heat generated in the semiconductor element **21** tends to increase. Additionally, since a coefficient of thermal conductivity of the package **26** sealing the semiconductor element is low, a resin-sealing semiconductor device is likely to have an inferior heat-dissipation characteristic.

However, in the semiconductor device **20**A according to the present embodiment, since the heat sink **30**A is so arranged as to oppose the semiconductor element **21**, the heat generated in the semiconductor element **21** is transferred by thermal conduction via the adhesive **24** to the heat sink **30**A, and further is transferred by thermal conduction via the solder **42** and the connection terminal **41**B to the mounting substrate **40**. In the course of this thermal conduction, the heat generated in the semiconductor element **21** is dissipated to outside. Additionally, the heat generated in the semiconductor element **21** is dissipated also via the terminal **25**, although an amount of heat dissipation is small. Arrows shown in FIG. **3** indicate heat-dissipation paths of the heat generated in the semiconductor element **21**.

Thus, since the semiconductor device **20**A comprises the heat sink **30**A, a heat-dissipation area can be widened, compared to a conventional structure in which heat dissipation is performed by the terminal **25** alone. Accordingly, the semiconductor element **21** can be cooled efficiently so as to surely prevent a malfunction from occurring in the semiconductor element **21**. Additionally, the lead-frame material having a high coefficient of thermal conductivity is used as the heat sink **30**A; also thereby, an excellent heat-dissipation characteristic can be obtained.

Subsequently, a description will be given, with reference to FIG. **4**, of a manufacturing method of the semiconductor device **20**A according to the above-described first embodiment.

The semiconductor device **20A** is manufactured by performing each of a lead frame forming step, an element mounting step, a sealing step, and a lead frame removing step. Additionally, when a plurality of semiconductor devices are formed from one lead frame, a severing step is added to the above-mentioned steps.

Here, the lead frame forming step is a step of forming a lead frame **31A** by forming a receding portion **44** at a position corresponding to the position at which the resin projection **28** is formed, and forming a coating of the metal film **29** inside the receding portion **44**. The element mounting step is a step of mounting the semiconductor element **21** on the lead frame **31A**, and electrically connecting the semiconductor element **21** with the metal film **29** by the wire **22**.

The sealing step is a step of forming the package **26** sealing at least the semiconductor element **21** and the wire **22**. The lead frame removing step is a step of removing the lead frame **31A** so as to make the semiconductor device **20A** independent. Further, the severing step is a step of separating a group of the continuous semiconductor devices from which the lead frame is removed into individual semiconductor devices in pieces.

The manufacturing method according to the present embodiment is characterized by the lead frame removing step, among all the above-mentioned steps; in the other steps, the same processes as conventional steps are performed. Accordingly, the following description is given only of the lead frame removing step characterizing the present embodiment.

FIG. **4A** shows a state after the lead frame forming step, the element mounting step, and the sealing step are finished. In this state, the metal film **29** and the resin projection **28** are formed inside each of a plurality of the receding portions **44** formed in the lead frame **31A**.

Additionally, the metal film **29** is electrically connected with the semiconductor element **21** by the wire **22**, and the resin projection **28** is formed unitarily with the package **26**. The semiconductor element **21** is fixed on the lead frame **31A** by the adhesive **24**. Besides, a thickness **W1** of the lead frame **31A** (a projection amount from the mount surface **38**) at this point is larger than a depth of the receding portion **44**, as a matter of course.

In the lead frame removing step, a process of separating the lead frame **31A** from the package **26** is performed. Specifically, an etching solution is jetted to the lead frame **31A** so as to dissolve the lead frame **31A**; thereby, the package **26** is separated from the lead frame **31A**. In the present embodiment, this lead frame removing step is realized by performing a first lead frame removing step and a second lead frame removing step.

In the first lead frame removing step, the etching solution is jetted to all surfaces of the lead frame **31A** so as to perform such an etching process that the lead frame **31A** is etched at a uniform rate throughout. The etching solution used in this etching process is selected for having a property of dissolving only the lead frame **31A** but not dissolving the metal film **29**.

This first lead frame removing step is performed until the thickness of the lead frame **31A** becomes equal to or smaller than a height (a dimension indicated by an arrow **W2** in FIG. **4B**) of the resin projection **28** including the metal film **29** from the mount surface **38**, in other words, until the thickness of the lead frame **31A** becomes equal to or smaller than a height of the terminal **25**.

FIG. **4B** shows a state after the first lead frame removing step is finished. In this state, the lead frame **31A** as a whole has a thickness equaling the above-mentioned **W2**. Therefore, in this state, a bottom part of the metal film **29** shares substantially the same plane as the lead frame **31A**, or protrudes slightly from the lead frame **31A**.

After the above-mentioned first lead frame removing step is finished, the second lead frame removing step is performed. In this second lead frame removing step, a resist **22** is provided on the lead frame **31A**, first. This resist **22** has an arrangement position so set as to correspond to a position at which the heat sink **30A** is formed.

Subsequently, as in the first lead frame removing step, the etching solution is jetted to all surfaces of the lead frame **31A** so as to perform an etching process to the lead frame **31A**. In this course, a portion of the lead frame **31A** on which the resist **32** is formed is not removed even by the etching process, but a portion of the lead frame **31A** on which the resist **32** is not formed is selectively etched. Thereby, the heat sink **30A** is formed, as shown in FIG. **4C**. Then, by removing the resist **32** provided on the heat sink **30A**, the semiconductor device **20A** is formed, as shown in FIG. **4D**.

Thus, in the present embodiment, utilizing the lead frame **31A** used upon manufacturing the semiconductor device **20A**, a part of the lead frame **31A** is caused to remain, in the first and second lead frame removing steps, so that the part becomes the heat sink **30A**. Therefore, manufacturing steps can be simplified, compared to a method of forming a heat sink from a material different from the lead frame **31A**. Additionally, a new manufacturing facility for forming the heat sink **30A** is also unnecessary so as to reduce facility costs. Further, since the present embodiment uses a method in which the lead frame **31A** is dissolved so as to separate the package **26** from the lead frame **31A**, this separating process can be performed surely and easily so as to increase a yield.

Besides, although the above-described embodiment sets forth the method for removing the lead frame **31A** by jetting the etching solution, the method for removing the lead frame **31A** is not limited thereto, and other etching methods can be used. Specifically, conceivable etching methods include a method in which the lead frame **31A** is soaked in an etching-solution bath filled with an etching solution loaded in an etching bath **31** so as to perform an etching thereby.

Next, a description will be given of a second embodiment according to the present invention.

FIG. **5** shows a semiconductor device **20B** according to the second embodiment of the present invention. Besides, in FIG. **5**, elements that are identical to the elements shown in FIG. **3** and FIG. **4** are referenced by the same reference marks, and descriptions thereof will be omitted. The same applies to FIG. **6** and following figures.

The semiconductor device **20A** according to the first embodiment shown in FIG. **3** has a structure in which the heat sink **30A** is provided under the semiconductor element **21** with the adhesive **24** therebetween. By contrast, the semiconductor device **20B** according to the present embodiment is characterized in that a plating layer **35** (a metal layer) is provided between the semiconductor element **21** and a heat sink **30B**. This plating layer **35** is formed by plating on an adhesive layer **33** provided under the semiconductor element **21**. The heat sink **30B** is bonded to the plating layer **35** with an adhesive layer **34** therebetween.

Thus, by providing a structure in which at least one layer of the plating layer **35** is provided between the semiconductor element **21** and the heat sink **30B** such that the heat sink **30B** is fixed to the plating layer **35** by bonding, a freedom of selecting the plating layer **35** and the adhesive **34** can be expanded.

Accordingly, by selecting the adhesive **34** as having an excellent adhesiveness to the heat sink **30**B, and by selecting the plating layer **35** as having an excellent adhesiveness to the adhesive **34**, the heat sink **30**B can be fixed firmly on the semiconductor device **20**B so as to improve a reliability of the semiconductor device **20**B. Additionally, since the plating layer **35** per se is a metal so as to have a high coefficient of thermal conductivity, the heat generated in the semiconductor element **21** can be efficiently transferred by thermal conduction to the heat sink **30**B.

Besides, although the present embodiment sets forth the structure in which one layer of the plating layer **35** is provided, the plating layer **35** is not limited to one layer, and a plurality of layers may be formed.

Next, a description will be given of third and fourth embodiments according to the present invention.

FIG. **6** and FIG. **7** show semiconductor devices **20**C and **20**D according to the third and fourth embodiments of the present invention. Each of the semiconductor devices **20**C and **20**D has a structure including a backside terminal **27**. This backside terminal **27** is a conductive metal film, and is so structured as to be connected to a grounding electrode pad of the semiconductor element **21** by the wire **22**, although not shown in the figures. Additionally, this backside terminal **27** is to be electrically connected to a ground terminal on a mounting substrate (not shown in the figures) upon mounting the semiconductor devices **20**C and **20**D on the mounting substrate. Accordingly, in the mounting state, the backside terminal **27** is connected to both the grounding electrode pad of the semiconductor element **21** and the ground terminal on the mounting substrate, and thereby functions as a shield member shielding the semiconductor element **21** so as to improve electric characteristics of the semiconductor devices **20**C and **20**D.

The semiconductor device **20**C according to the third embodiment shown in FIG. **6** has a structure in which a heat sink **30**C made of metal is provided between the backside terminal **27** and the semiconductor element **21**. This heat sink **30**C is fixed to the backside terminal **27** by the adhesive **24**. The semiconductor element **21** is mounted on top of the heat sink **30**C by the adhesive **24**.

On the other hand, the semiconductor device **20**D according to the fourth embodiment is characterized by using a heat sink **30**D made of resin. This heat sink **30**D has a structure in which metal powder is mixed in a resin having a high coefficient of thermal conductivity so as to have a high coefficient of thermal conductivity as a whole. Additionally, heating the heat sink **30**D made of resin causes the resin to have adhesiveness like an adhesive; therefore, the semiconductor element **21** and the heat sink **30**D, and the backside terminal **27** and the heat sink **30**D are so structured as to be connected directly to each other by an adhesion force that the heat sink **30**D per se yields.

In each of the semiconductor devices **20**C and **20**D structured as above, since the heat sink **30**C or **30**D is provided between the semiconductor element **21** and the backside terminal **27**, the heat generated in the semiconductor element **21** is first transferred by thermal conduction to the heat sink **30**C or **30**D, and thereafter is transferred by thermal conduction to the backside terminal **27** so as to be emitted to outside.

In this course, since the backside terminal **27** is joined to the mounting substrate (not shown in the figures) upon mounting, the heat generated in the semiconductor element **21** is dissipated not only from the backside terminal **27** but also from the mounting substrate. Thus, providing the heat sink **30**C or **30**D between the semiconductor element **21** and the backside terminal **27** enables an increase in a heat-dissipation capacity so as to perform an efficient heat-dissipation process.

Additionally, the semiconductor device **20**D according to the fourth embodiment has a structure in which the semiconductor element **21** is placed directly on top of the heat sink **30**D so that the heat generated in the semiconductor element **21** can be directly dissipated to the heat sink **30**D; thus, a heat-dissipation efficiency can be improved.

Next, a description will be given of a fifth embodiment according to the present invention.

FIG. **8** shows a semiconductor device **20**E according to the fifth embodiment of the present invention. The semiconductor device **20**E according to the present embodiment is characterized in that a heat sink **30**E is provided on top of the semiconductor element **21**. The heat sink **30**E is made of metal, and is composed of a plate-form portion **36**A and a protruding portion **36**B.

In the present embodiment, the plate-form portion **36**A is so structured as to cover all over an upper surface of the package **26**. However, the plate-form portion **36**A is not necessarily so structured as to cover all over the upper surface of the package **26**, and an area thereof is variable according to an amount of the heat generated in the semiconductor element **21**.

The protruding portion **36**B is so formed as to protrude from the plate-form portion **36**A toward the semiconductor element **21**. An end surface of this protruding portion **36**B is bonded to the upper surface of the semiconductor element **21** by a soft adhesive **37**. At this point, the soft adhesive **37** is used for bonding the protruding portion **36**B to the semiconductor element **21** for the purpose of protecting a circuit formed on the upper surface of the semiconductor element **21**.

Subsequently, a description will be given of a manufacturing method of a semiconductor device according to a second embodiment of the present invention.

In the manufacturing method of the semiconductor device described with reference to FIG. **4**, the semiconductor device **20**A is formed by using only one surface of the lead frame **31**A. By contrast, in the manufacturing method according to the present embodiment, semiconductor devices are formed on both surfaces of a lead frame so as to improve productivity.

FIG. **9** and FIG. **10** show lead frames **31**B and **31**C used in the manufacturing method according to the present embodiment. In the lead frame **31**B, the receding portions **44** are formed at each of an upper surface and an undersurface of one metal base **45**A, and the metal film **29** is formed on inner surfaces of each of the receding portions **44**. It is arranged that the receding portions **44** are formed at positions corresponding to positions at which the terminals **25** of the semiconductor devices are formed.

In the lead frame **31**C, a metal base **45**B is composed of first and second half bases **46** and **47**. The receding portions **44** are formed at one surface of each of the half bases **46** and **47**, and the metal film **29** is formed on the inner surfaces of each of the receding portions **44**. Surfaces of the half bases **46** and **47** at which the receding portions **44** are not formed are placed so as to oppose each other, and are joined by a base adhesive **48**. Thereby, the first and second half bases **46** and **47** are united so as to compose the lead frame **31**C. Besides, a method of joining the first and second half bases **46** and **47** is not limited to a method using the base adhesive **48** as mentioned above; a method of joining the first and

second half bases **46** and **47** by performing a rolling processing mechanically may be used, for example.

The lead frames **31**B and **31**C structured as above are manufactured as follows. It is noted that the following description will be given by taking a manufacturing method of the lead frame **31**C as an example.

In order to manufacture the lead frame **31**C, first, as shown in FIG. **11**, the first and second half bases **46** and **48** in the form of flat plates made of conductive materials (e.g., copper) are prepared, and this pair of the half bases **46** and **48** are bonded to each other by the base adhesive **48** so as to form the metal base **45**B. Subsequently, as shown in FIG. **12**, etching resists **49** are applied on both upper and under surfaces of this metal base **45**B (a resist applying step). This etching resist **49** is a photosensitive resin, for example, and is applied by using a spinner, etc. so as to have a predetermined thickness.

Subsequently, an exposing process is performed to the etching resists **49** by using masks not shown in the figures, and thereafter, a developing process is performed so as to form resist patterns **49***a* in which openings **50** are formed at the positions at which the terminals **25** are formed later (a resist pattern forming step). FIG. **13** shows the resist patterns **49***a* in which the openings **50** are formed.

After the resist pattern forming step is finished, a half etching process is performed to both surfaces of the metal base **45**B on which the resist patterns **49***a* are formed so that the receding portions **44** are formed at both surfaces of the metal base **45**B (an etching step). The depth of the receding portion **44** is equivalent to the height of the terminal **25** formed later, and the receding portion **44** is so formed as to be 0.05–010 mm in depth. The depth of this receding portion **44** is caused to be the above-mentioned predetermined depth by controlling an etching time. Besides, when a copper (Cu) is used as a material forming the metal base **45**B, a ferric chloride, for example, can be used as an etching solution. FIG. **14** shows the metal base **45**B at both surfaces of which the receding portions **44** having the predetermined depth are formed.

When the etching step is performed as described above, a metal-film forming step is subsequently performed so as to form the metal film **29**. A plating method, for example, can be used as a method of forming the metal film **29**. Additionally, the metal film **29** according to the present embodiment is a four-layer structured film in which a solder layer, a nickel (Ni) layer, a palladium (Pd) layer, and a gold (Au) layer are stacked, from an inner layer. Therefor, each of the layers is plated and stacked in succession so as to form the metal film **29**. Besides, a layer structure of the metal film **29** is not limited to the above-mentioned combination, and the metal film **29** may be a four-layer structured film in which a palladium (Pd) layer, a nickel (Ni) layer, a palladium (Pd) layer, and a gold (Au) layer are stacked, from the inner layer.

By performing the above-described process, the metal film **29** is formed in the metal base **45**B by coating, as shown in FIG. **15**. However, upon separating the package **26** from each of the half bases **46** and **47** in a separating step as described hereinafter, the metal film **29** also needs to be parted from each of the half bases **46** and **47**. Therefor, the metal film **29** is required to have a certain degree of separability with respect to each of the half bases **46** and **47**. Accordingly, it may be arranged that, prior to forming the metal film **29** in the receding portion **44**, for the purpose of securing the above-mentioned separability, a material improving the separability, such as a conductive paste, is applied in the receding portion **44**, upon which the metal film **29** is formed.

Besides, although the method of forming the metal film **29** by using a plating method is described in the above-mentioned metal-film forming step, a formation of the metal film **29** is not limited to the plating method; and the metal film **29** may be formed by using other film-formation techniques, such as a deposition method and a sputtering method, for example.

After the metal film **29** is formed in the receding portion **44** in the metal-film forming step, a resist removing step for removing the resist patterns **49***a* (the etching resists **49**) and a surface smoothing step for the metal base **45**B are performed so as to form the lead frame **31**C shown in FIG. **10**. In the above-described manufacturing method of the lead frame **31**C, the lead frame **31**C can be formed by using simple steps, such as the resist applying step, the resist pattern forming step, the etching step, the metal-film forming step, and the resist removing step.

Subsequently, a description will be given of the manufacturing method of a semiconductor device by using the lead frame **31**C manufactured as described above.

In order to manufacture the semiconductor device, the adhesive **24** is applied at a predetermined element mounting position on the lead frame **31**C, and the semiconductor element **21** is mounted on top of this adhesive **24** (an element mounting step). When this element mounting step is finished, the lead frame **31**C is mounted on a wire bonding machine, and the wire **22** is provided between the electrode pad formed on the upper surface of the semiconductor element **21** and the metal film **29** formed in the lead frame **31**C so as to electrically connect the semiconductor element **21** and the metal film **29** to each other, as shown in FIG. **16** (a connecting step).

After the above-mentioned connecting step is finished, the package **26** sealing a plurality of the semiconductor elements **21** formed on the lead frame **31**C is formed (a sealing step). FIG. **17** shows a state where the package **26** is formed. Although FIG. **17** shows an example where the package **26** is formed by transfer-molding, this package **26** can be formed also by other resin forming methods, such as potting. When applying the transfer-molding, the package **26** can be formed at a low cost with high reliability; on the other hand, when applying the potting, a manufacturing facility can be simplified, and a cost thereof can be lowered.

After the above-mentioned sealing step is finished, a dividing step for dividing the first half base **46** and the second half base **47** is performed. In this dividing step, the base adhesive **48** is chemically dissolved so as to divide the first and second half bases **46** and **47**. Thereby, the first and second half bases **46** and **47** can be dealt with independently. FIG. **18** shows a state where the first and second half bases **46** and **47** are divided.

Besides, a method for dividing the first and second half bases **46** and **47** is not limited to a method of dissolving the base adhesive **48** chemically as described above; for example, a method can be used in which a resin softening by heating (which needs to have a lower softening point than the resin forming the package **26**) is used as the base adhesive **48** so that the first and second half bases **46** and **47** divide by performing a heating process.

After the above-mentioned dividing step is finished, the separating step for separating the package **26** from the first and second half bases **46** and **47** is performed. FIG. **19** shows the separating step; an example shown in this figure illustrates a method in which the first and second half bases

46 and 47 are dissolved by jetting an etching solution to divided faces of the first and second half bases 46 and 47 so as to separate the package 26 from the first and second half bases 46 and 47.

The etching solution used in this separating step is selected for having a property of dissolving only the first and second half bases 46 and 47 but not dissolving the metal film 29. Accordingly, the first and second half bases 46 and 47 are completely dissolved so that the package 26 is separated from the first and second half bases 46 and 47.

Thus, by using the method in which the first and second half bases 46 and 47 are dissolved so as to make the package 26 separate and independent, a process of separating the package 26 from the first and second half bases 46 and 47 can be performed surely and easily so as to increase a yield.

Besides, a method for separating the package 26 from the first and second half bases 46 and 47 is not limited to the above-described method of dissolving the first and second half bases 46 and 47; for example, a method can be used in which the package 26 is mechanically separated from the first and second half bases 46 and 47 by peeling the package 26 from the first and second half bases 46 and 47.

In this separating method, the etching solution becomes unnecessary, and a time required for the separating step can be shortened, compared to the method according to the above-mentioned embodiment. However, since the package 26 is mechanically separated from the first and second half bases 46 and 47, there is a point in question whether or not the metal film 29 surely transfers from each of the receding portions 44 to the resin projection 28. However, this point can be solved by forming the metal film 29 after providing a material (an agent) improving the separability of the metal film 29 in the receding portion 44, in the above-described metal-film forming step.

After the above-mentioned separating step is finished, a severing step is performed. In this severing step, a plurality of the packages 26 in a continuous state are severed into individual packages 26. In the present embodiment, a cutting saw 51 is used as a jig for severing a resin-sealing member 27, as shown in FIG. 20. This cutting saw 51 has the same structure as a dicing saw used in severing a wafer, and enables a highly precise severing process with an extremely narrow severing margin. Besides, other than the cutting saw 51, the separating process can be performed by using a laser light or an electronic beam, for example.

Subsequently, as shown in FIG. 21, a heat sink 30F is fixed to the mount surface 38 of the package 26 by an adhesive 52 (a heat sink providing step), whereby a semiconductor device 20F is formed. By performing the heretofore-described steps, the semiconductor device 20F is manufactured. According to the above-described manufacturing method, the semiconductor element 21 can be mounted and processed on each of both surfaces of the lead frame 31B or 31C. Therefore, a lead-frame cost required for manufacturing one semiconductor device 20F can be halved, and thus a manufacturing cost can be reduced. Additionally, since a multitude of the semiconductor devices 20F can be formed all at one time, a manufacturing efficiency can be improved.

As described above, according to the present invention, the heat generated in the semiconductor element is dissipated at the heat-dissipation member; therefore, the semiconductor element can be cooled efficiently so as to prevent a malfunction from occurring in the semiconductor element.

Additionally, since the projection amount of the heat-dissipation member from the mount surface is set equal to or smaller than the projection amount of the resin projection including the metal film, the heat-dissipation member does not thwart the joining of the metal film and the mounting substrate upon mounting the semiconductor device.

Additionally, according to the present invention, the heat-dissipation member is a metal plate formed of the lead-frame material so as to obtain an excellent heat-dissipation characteristic because the lead-frame material has a high coefficient of thermal conductivity.

Additionally, according to the present invention, a material having an excellent adhesiveness can be used as the metal layer so as to fix the heat-dissipation member firmly. In addition, since the metal layer per se has a thermal conductivity, the heat generated in the semiconductor element can be efficiently transferred by thermal conduction to the heat-dissipation member.

Additionally, according to the present invention, by providing the heat-dissipation member between the semiconductor element and the backside terminal, a heat-dissipation capacity can be increased so as to perform an efficient heat-dissipation process.

Additionally, according to the present invention, the heat generated in the semiconductor element can be directly dissipated to the heat-dissipation member so as to improve a heat-dissipation efficiency. Also, the heat-dissipation member can be used as a substrate on which the semiconductor element is mounted.

Additionally, according to the present invention, utilizing the lead frame used upon manufacturing the semiconductor device, a part of the lead frame is caused to remain, in the first and second lead frame removing steps, so that the part becomes the heat-dissipation member; therefore, manufacturing steps can be simplified, compared to a method of forming a heat-dissipation member from a material different from the lead frame. In addition, a new manufacturing facility for forming the heat-dissipation member is also unnecessary so that facility costs do not increase.

Further, according to the present invention, a lead-frame cost required for manufacturing one semiconductor device can be reduced, and thus a manufacturing cost can be reduced. In addition, since a multitude of the semiconductor devices can be formed all at one time, a manufacturing efficiency can be improved.

The present invention is not limited to the specifically disclosed embodiments, and variations and modifications are conceivable without departing from the claimed scope of the present invention.

What is claimed is:

1. A semiconductor device comprising:

a semiconductor element;

a resin package sealing said semiconductor element;

a plurality of resin projections formed on a mount side of said resin package so as to protrude thereon;

a metal film provided on said resin projection;

a wire electrically connecting an electrode pad on said semiconductor element and said metal film to each other; and

a heat-dissipation member provided opposite said semiconductor element so as to dissipate heat generated from said semiconductor element,

wherein a projection amount of said heat-dissipation member from said mount surface is arranged to be equal to or smaller than a projection amount of said resin projection including said metal film.

2. The semiconductor device as claimed in claim 1, wherein said heat-dissipation member is a metal plate formed of a lead-frame material.

3. The semiconductor device as claimed in claim 1 or 2, further comprising at least one metal layer provided between said semiconductor element and said heat-dissipation member, and

wherein said heat-dissipation member is fixed to said metal layer by bonding.

4. A semiconductor device comprising:

a semiconductor element;

a resin package sealing said semiconductor element;

a plurality of resin projections formed in a peripheral form on a mount side of said resin package so as to protrude thereon;

a metal film provided on said resin projection;

a backside terminal formed inside positions on said mount side at which said resin projections are provided so as to protrude thereat;

a wire electrically connecting an electrode pad on said semiconductor element and said metal film to each other; and

a heat-dissipation member provided between said semiconductor element and said backside terminal.

5. The semiconductor device as claimed in claim 4, wherein said semiconductor element is placed on said heat-dissipation member.

6. A manufacturing method of a semiconductor device comprising:

a semiconductor element;

a resin package sealing said semiconductor element;

a plurality of resin projections formed on a mount side of said resin package so as to protrude thereon;

a metal film provided on said resin projection;

a sire electrically connecting an electrode pad on said semiconductor element and said metal film to each other; and

a heat-dissipation member comprising a metal plate formed of a lead-frame material provided opposite and semiconductor element so as to dissipate heat generated from said semiconductor element,

wherein a projection amount of said heat-dissipation member from said mount surface is arranged to be equal to or smaller than a projection amount of said resin projection including said metal film, said method comprising:

a lead frame forming step of forming a lead frame by preparing a substrate formed of the lead-frame material, forming a receding portion at a position in said substrate corresponding to a position at which said resin projection is formed, and coating inside of said receding portion with said metal film;

an element mounting step of mounting said semiconductor element on said lead frame, and electrically connecting said semiconductor element ad said metal film to each other by said wire;

a sealing step of forming said resin package sealing at least said semiconductor element and said wire;

a first lead frame removing step of removing said lead frame so that a thickness of said lead frame becomes equal to or smaller than a height of said resin projection including said metal film from said mount surface; and

a second lead frame removing step of providing a resist material at a predetermined position on said lead frame at which to form said heat-dissipation member, and thereafter, removing said lead frame on which said resist is not provided so as to form said heat-dissipation member.

7. A lead frame used upon manufacturing a semiconductor device comprising:

a semiconductor device;

a resin package sealing said semiconductor device;

a resin projection formed on a mount surface of said resin package so as to protrude thereon;

a metal film provided on said resin projection;

connecting means for electrically connecting an electrode pad on said semiconductor element and said metal film to each other; and

a receding portion formed at a position in a base corresponding to a position at which said resin projection is formed, the receding portion having said metal film formed therein, is formed at opposite surfaces of said base.

8. The lead frame as claimed in claim 7, wherein said metal film is a four-layer structured film of a solder layer, a nickel (Ni) layer, a palladium (Pd) layer, and a gold (Au) layer, from an inner layer, or a four-layer structured film of a palladium (Pd) layer, a nickel (Ni) layer, a palladium (Pd) layer, and a gold (Au) layer, from the inner layer.

9. The lead frame as claimed in claim 7 or 8, wherein said base is composed of first and second half bases at one surface of each of which said receding portion is formed, and surfaces of said first and second half bases at which said receding portion is not formed are joined to each other.

10. A manufacturing method of a lead frame comprising:

a semiconductor device;

a resin package sealing said semiconductor device;

a resin projection formed on a mount surface of said resin package so as to protrude thereon;

a metal film provided on said resin projection;

connecting means for electrically connecting an electrode pad on said semiconductor element and said metal film to each other; and

a receding portion formed at a position in a base corresponding to a position at which said resin projection is formed, the receding portion having said metal film formed therein, is formed at opposite surfaces of said base, said method comprising:

a resist applying step of applying etching resists on both surfaces of the base;

a resist pattern forming step of forming predetermined resist patterns by removing portions of said etching resists corresponding to said receding-portion forming positions;

an etching step of forming the receding portions at said receding-portion forming positions at both surfaces of said base by using the resist patterns as masks;

a metal-film forming step of forming said metal films in the receding portions formed in said etching step; and

a resist removing step of removing said etching resists.

11. A manufacturing method of a semiconductor device by using the lead frame comprising:

a semiconductor device;

a resin package sealing said semiconductor device;

a resin projection formed on a mount surface of said resin package so as to protrude thereon;

a metal film provided on said resin projection;

connecting means for electrically connecting an electrode pad on said semiconductor element and said metal film to each other; and

a receding portion formed at a position in a base corresponding to a position at which said resin projection is formed, the receding portion having said metal film formed therein, is formed at opposite surface of said base,

wherein said base is composed of first and second half bases at one surface of each of which said receding portion is formed, and surfaces of said first and secondhalf bases at which said receding portion is not formed are joined to each other, said method comprising:

an element mounting step of mounting the semiconductor element on said lead frame;

a connecting step of electrically connecting an electrode pad formed on said semiconductor element and said metal film formed in said lead frame to each other;

a sealing step of forming a resin on said lead frame, the resin sealing said semiconductor device, so as to form the resin package;

a dividing step of dividing said lead frame into said first half base and said second half base; and

a separating step of separating said resin package together with said metal film from said first and second half bases.

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